the IMPACT Conference Lectures

JUL 17 1969
STATE DOCUMENTS
S
658.505
M44C

COMPUTERS IN STATE GOVERNMENTS

Edited by
Patricia P. Douglas
Rauf A. Khan

Bureau of Business and
Economic Research
School of Business Administration
University of Montana, Missoula

MONTANA STATE LIBRARY
S 658.505 M44c c.2
Computers in State governments;proceedin
3 0864 00018579 6

Computers
in
State Governments

Digitized by the Internet Archive
in 2016

https://archive.org/details/computersinstate1969impa

Computers
in
State Governments

The proceedings of the IMPACT conference on computer applications held in Helena, Montana on November 14-15, 1968

Presented By

Bureau of Business and Economic Research
University of Montana, Missoula

In Cooperation With

Department of Planning and Economic Development
State of Montana

June 1969

Foreword

Despite a surfeit of spectacular accomplishments utilizing computers, state and local governments have been slow in recognizing their importance. Recently, however, individual agencies have begun to adapt electronic data processing to their internal needs. Cooperation among state and local agencies, the legislature and the governor's office is making comprehensive planning, statewide information systems and planning-programming-budgeting systems realities instead of textbook phenomena.

With the information explosion, computers are assuming an all-important role of information purveyors. Business, industry and government are devoting prodigious sums of money and talent to appraise and effectively utilize computers for management purposes. This accelerated use of computers has, in turn, precipitated a myriad of unresolved questions which demand practical answers. Limited resources further demand that users and developers learn from one another.

Those who will be responsible for designing and implementing future systems must recognize the importance of evaluating their own efforts in terms of the practical solutions other users have found during their own developmental stages. Thus, current users form the nuclei of this educational endeavor, one which stresses the evaluation of operating systems. This was the primary goal of IMPACT, a two-day conference which emphasized the advantages and pitfalls of computer applications in state and local government.

This publication presents the lectures delivered at IMPACT. These lectures reflect actual situations and results, not panaceas. From the keynote address given by the Honorable Tim Babcock to the concluding discussion of challenges facing state administrators, the thread which held the speakers and the participants together was the idea of change and the necessity for developing concepts and procedures to more effectively process, manage, analyze and control information.

The state of Montana was indeed fortunate to be able to draw these experts from all over the United States to give practical evaluative presentations covering computer applications. On behalf of the Bureau of Business and Economic Research, the Department of Planning and Economic Development, and state and local agencies, we extend our sincere thanks to the speakers who made this publication possible.

We would also like to acknowledge the efforts of Linda M. McDonald and Dorothy A. Burger who exhibited such zealous interest and remarkable patience with hastily written notes and comments. Although they were instrumental in creating this publication, the speakers and editors are solely responsible for its content.

Patricia P. Douglas
Rauf A. Khan
Editors

Missoula, Montana
June 1969

Contents

FOREWORD v

MONTANA IN A CHANGING ENVIRONMENT 1
Governor Tim Babcock

MANAGERS AND INFORMATION 7
M. H. Schwartz

THE ELECTRONIC ABACUS 13
Jack J. Kempner

CHARACTERISTICS OF COMPUTER-BASED INFORMATION SYSTEMS 19
Marvin W. Ehlers

COMPUTER-BASED STATEWIDE INFORMATION SYSTEMS . . 27
Donald D. Scriven

EXPERIENCES WITH A STATEWIDE DATA PROCESSING PROGRAM 35
Carl W. Vorlander

THE CHANGING WINDS OF MONTANA 41
K. Ross Toole

EXECUTIVE, LEGISLATIVE AND JUDICIAL CONSIDERATIONS FOR INFORMATION SYSTEMS 47
John A. Kennedy

PPBS—A NEW DIMENSION IN FINANCIAL PLANNING AND MANAGEMENT FOR GOVERNMENTS 55
Kenneth S. Caldwell

CENTRALIZED COMPUTER SERVICES FOR INTERNAL MANAGEMENT 63
Gary A. McLean

PRACTICAL APPLICATIONS OF COMPUTERS IN THE PUBLIC SCHOOLS 69
Dudley Solomon

TODAY'S CHALLENGE FOR TOMORROW'S MANAGERS 75
Patricia P. Douglas

Keynote Address

HONORABLE TIM BABCOCK

Mr. Tim Babcock served as governor of Montana from 1961 to 1968. He is currently Vice-President of Occidental International Corporation (a subsidiary of Occidental Petroleum) in Washington, D.C.

HONORABLE TIM BABCOCK

Montana in a Changing Environment

Distinguished speakers and guests. Ladies and gentlemen. Let me welcome you to Montana and IMPACT. I am happy to see a majority of the federal and state agencies in Montana represented here today and wish that more of your colleagues in the neighboring states would have been able to attend. For those of you who were able to arrange time to come to Helena, we are glad to have you here and hope that your trip will be both professionally and personally rewarding.

For the past seven years as Montana's chief administrator, I am acutely aware of the changes which are occurring in state and local government, particularly in Montana. Let us briefly review some of the changes which specifically relate to the topics which you will be discussing during the next two days:

1. During the last legislative session, the responsibility for designing and implementing a statewide information system was given to the Department of Planning and Economic Development;
2. We have begun comprehensive planning on a broad scale, both at the state and local levels;
3. An economic base study has been started, the first of many studies to be undertaken within the framework of comprehensive planning;
4. The Civil Defense Agency, in cooperation with several other federal, state and local agencies, is in the process of developing a massive communication network for the state;
5. Numerous individual agencies are developing, and some are operating their own internal data processing systems;
6. State and local agencies are increasing their expenditures for research and development; and
7. A project to develop an informational network for law enforcement has been approved.

Along with these changes we should keep in mind the modifications that are being forced upon all levels of government by the increasing demand for services already offered, such as those in the areas of public safety, public health, recreation, industrial development, mental health, mental retardation, and education—the probable magnitude of future needs in these areas is indeed impressive. The list could be expanded but these examples are representative of the kinds of developments occurring in Montana. More important than the changes themselves is the framework within which these changes are designed, implemented, controlled and operated. I believe that the framework will ultimately determine whether these changes become an asset or a liability to this state. Because that framework has not yet been totally spelled out, these changes are both exciting and challenging.

They are exciting because they all have the potential of improving the quality and timeliness of information upon which key federal, state and local decisions are made. There was a time when decisions made within any one of these governmental levels was almost completely independent of the others; it was certainly true that the decisions made in one small county or city within Montana had little or no effect upon a national or state policy decision. This situation has changed; there is a growing interdependence, especially regarding information, among the various governmental levels. The decisions which are made at one level to influence and guide the decisions made at higher or lower ones. Whether or not you agree with this trend is not the issue—it is a fact that we have to live with. Each level of government not only needs to know what decisions are being made at other tiers, but also each level must have some knowledge of the information upon which those decisions were made. Furthermore, this growing interdependence places a high priority on accurate, timely and relevant information. It is exciting to think that Montana is working toward the goal of providing better information to its decision makers.

These changes are also exciting because they are very recent ones. The fact that they are recent means that we can utilize them fully; we do not have to clear out great quantities of prior mistakes before embarking on these projects. Similarly, we have the procedures and results from other states to guide us in our efforts—and you will hear more about those during this two-day session. They are exciting because they will, if designed and implemented properly, avoid much of the duplication which currently exists in the area of data and information processing, handling, storage and dissemination. We do not have the time, money or manpower to suggest that each agency and department at every governmental level be unilaterally responsible for obtaining all that information which it needs to make decisions, nor can we afford the costs of individual and uncoordinated attempts at implementing any one of these changes; each is an integral part of the others.

Many of the same facets which make these changes exciting also make them challenging, almost frightening. Because the concepts of information systems, planning-programming-budgeting systems, comprehensive planning and communication networks are intriguing, they are subjects of considerable discussion. However, we tend to get so impressed with their aura of mystery and the resulting discussions that we fail to ask ourselves what these concepts really mean. That is, these concepts have not all been made explicit and understandable in state and local government.

External pressures also make these changes challenging. If we were to gauge our activity in information processing, communications, comprehensive planning and all of the other changes by the level of activity in other states, we would find that Montana lags far behind. Furthermore, it is becoming quite clear that if we in Montana and states like Montana intend to undertake joint activities with the federal government—where many of these concepts are past the discussion stage—we must be ready and willing to adapt them to our existing governmental structure with very little time for adjustment.

This is not meant to imply that we should necessarily have been involved in these activities much sooner. Rather, that although the time has come for our involvement, we should not be pressured by other states and other units of government to initiate and implement these changes before we have a well-established framework for development. On the other hand, it is difficult to move slowly because the internal pressures are commensurate with, if not greater than, the external ones. Increasing work loads, rising costs, and relatively unskilled employees are gradually forcing individual agencies and local governmental units to undertake these projects singly and without regard to the total framework for change: for example, some communities, in the effort to attract new industry, are drawing up their own "plans" for development without regard for the state's plan. As another example, individual agencies, departments and local governmental units are designing or financing outsiders to design a system for their data processing needs—a system which may only consider that particular agency's or department's needs in relation to the internal and external requirements that exist now, rather than in relation to those which probably will exist ten years from now. These many examples suggest to me that unless we move rapidly we will soon lose the advantage I mentioned earlier, that of not having to deal with past mistakes before we can embark on these new projects.

To advance rapidly but within a framework of well-defined goals and policies requires, in addition to absolute administrative support—both within agencies and within the administrative level of state government—two very important factors: first, sufficient resources and secondly, a willingness to cooperate in areas that have, up until now, been the sole responsibility of individuals within each federal, state and local agency. Through my personal association with governmental units in Montana and by looking at the broad representation in the audience, I have little doubt but what the second requirement, that of cooperation, can be achieved. The other prerequisite of sufficient resources is more difficult to predict, not because legislators are opposed to change, but because they tend to view change as occurring within the traditional agency or department boundaries, rather than encompassing all agencies and departments.

If we look at the situation around the country, legislative interest in information technology has taken several directions. In some states, legislators seem to be insistent upon developing these concepts around individual agencies and departments; in other states, they have taken a broader view—relating these concepts to the legislative, judicial and administrative branches, with individual agencies, departments and local units assuming the responsibility for directing these broader efforts. Gradually, however, there appears to be wide legislative concern with the costs and effectiveness of "proliferating" applications of new technology in state agencies. Several legislative state agencies have undertaken studies in this field. Unfortunately, I do not detect this kind of legislative concern in Montana which places an additional burden on the administrators of federal, state and local agencies.

Several times I have mentioned or alluded to the framework for change. By "framework for change" I mean both the attitudes we take toward change and the overall planning mechanism—the goals, procedures, and policies which must necessarily underlie an extensive but coordinated effort to change. We do not need a planning design for Wibaux County, for the Department of Public Instruction, for the educational system, for recreation or for transportation. Instead we need a total design for progress, a design for Montana, one which can utilize all of the energies of our citizens and all of the power of their institutions.

Now there is no question in my mind that this undertaking will be difficult for we still have many questions that remain unanswered, one which must be answered before the total framework is complete: how well are our institutions and agencies equipped to handle the pressing demands of what we need now, against what we will need ten years from now, and twenty? How do we determine the proper spending level for a given activity? How much open space will we require in the future and who shall determine what its best use is? What are the projected needs of economic growth, compared to the requirements for recreation and open space, capital investment against educational investment? How do we best cope with the transportation problems facing our state?

I think these are all legitimate questions which must be answered if we are to provide a framework for change in Montana and if we are to make changes in this state. To answer them completely and successfully we will have to achieve some important changes in the planning process. As I said earlier, there is no doubt that this will be difficult. On the other hand, I think we have the basic ingredients to do so. Those of you in the audience represent the single most important ingredient. And I think an educational program such as IMPACT is the way to begin.

Managers and Information

M. H. SCHWARTZ

As the Assistant Controller for Information Systems, U.S. Atomic Energy Commission, Mr. Schwartz is primarily responsible for planning, implementation and operation of the Commission's management information systems. Preceding his present appointment, he was the Vice-President of the First National City Bank, New York; he was also associated with the Board of Governors of the Federal Reserve System. Mr. Schwartz has held several positions with the Federal Government including that of a statistician, economist and Director of the Office of Business Economics. Concurrent with his regular duties, he is also a consultant to the Rand Corporation and Organization for Economic Cooperation and Development in Paris. Mr. Schwartz is a noted lecturer and writer in the field of management, information and computers.

M. H. SCHWARTZ

Managers and Information

My objective is to set the stage for this two-day conference in which we will explore the many ways in which computer-based information systems can contribute to the improvement of the administration of state affairs. It is my understanding that this conference will also reveal some of the problems that we encounter in attempting to harness the computer for use in information systems. The potentials for information systems are great, but these potentials come only after conquering severe problems, both human and technical. That is, there are great opportunities, but they don't come for nothing. They will demand substantial effort on the part of those who are interested in such a system, an effort you will find justified because the payoff will be substantial.

Managers are the most important component of the subject, "Managers and Information." To me, management rests upon three bases: first, there are certain necessary human attributes in a good manager. I do not know how many are inborn and how many are developed, but I do know that the successful manager at maturity does possess at least some measure of all of the human attributes required for effective management. The most important of these are judgment, insight, motivation, the ability to follow through, integrity and decency. The importance lies not in how many of these attributes a specific man may have, but that we recognize that effective management rests upon these human attributes.

The second basis of management is the application of these attributes through certain principles and skills to management problems. If someone were to ask me to identify a crucial principle of management, I think I would say planning—the specifying of objectives and the formulation of solutions to problems. This is the planning process in very, very few highly over-simplified words, but I do identify planning as a crucial principle of management. Among the skills of management, I would rank highest the ability to work with other people—subordinates, peers and seniors.

So if we take the first two bases for effective management—human attributes and skills—the third basis can become the focal point for our discussion today and tomorrow, namely, information. After all it is information, knowledge about issues, about prospects, about people, about organizations, about resources, that the manager must have at his disposal if he is to apply his best attributes and skills to managing the problem. Just as management at all levels should seek to develop and foster and strengthen the desire for superior human attributes and knowledge of the principles and skills of management, so really all levels of management should develop and strengthen the information process. Information is the nonhuman component of effective management and it is the bridge between the human and the issues. Achieving objectives in no small part rests upon the quality of relevant information.

Now information itself is a frequently used term, although few of us have really stopped to examine what we really mean when we use the word. I have one definition which is drawn from the mathematical theory of information. Information begins as a string of symbols. This string of symbols may be presented to us on paper in the form of a telegram or a letter or a memorandum or a book or a table or a chart. It may be presented to us orally, either through face-to-face contact or through some electrical transmission method such as radio or television. In any event, information begins as a string of symbols and the ensemble of symbols about which we are talking comprise a message. Now a message has a high information content, that is, it has significant information when we do not expect to receive the message. The information content of a message may be said to be inversely proportional to the probability of receiving that message. I think the best way to simplify this mathematical notion is to say that as long as we continue to receive messages about events we already know exist or events which we expect to occur, then we simply take the messages for granted. They do not trigger any action on our part. It is the message that tells us about change, the unexpected, about something new that contains a high information content and that triggers us to act, to do something we would not have done had we not received the message. This, then, sets the goal, the overriding goal, for the design of information systems, whether they are computer-based, manual, clerical-based, or whatever. We want our information systems to tell us about the unexpected, about the new.

One of the problems confronting information systems developers today is coping with the huge quantities of data which modern computers can turn out at such furious rates. The problem is to identify, wherever possible, the unexpected and to suppress the expected. This is called, in textbooks on management, "management by exception." It is not easy to design information systems that present to the human being only those salient data which become information because they are new and different and contain messages about change. But I think it is helpful to set that goal, difficult to achieve though it may be.

Thus it is possible to identify three effective bases of management: certain human attributes, certain principles and skills, and information—identified as messages about change, about the unexpected, about the new. There is a relationship between management and information, or, more exactly, between the levels of management and the levels of information. At the bottom level of management we have immediate supervision—in the office, for example, the clerical supervisor. These lowest levels of management are interested in streams of information. They are interested in the details of transactions and the details about events. They deal with streams of facts. The primary function of that lowest level of management is the immediate control of activities, the responsibility to see to it that things are done in accordance with the directives from higher levels of management. Detailed control rests upon detailed information, so consequently the lowest levels of management want the lowest levels of information.

The middle level of management is concerned partly with control and supervision, but also partly with planning. Middle managers not only attempt to follow through on activities which have been scheduled—the control process—but they also play an important part in determining what activities should be scheduled, and this is planning. This middle level of management, which generally sits over a number of lower-line managers, cannot rely on the same detailed information as does the subordinate level below it. The many facts going across the desks of the lowest levels of management will hopelessly swamp the middle manager. Hence, the middle manager really wants summaries and statistics which draw upon those facts to bring forth the critical summary about the massive detail.

Now let's turn to the top level of management, the planners. The top manager wants a very high level of information. What he wants is the results of simulation studies, that kind of information which is the most difficult to achieve; he wants information about the future, the best forecasts he can get. Above all, he is interested in what is likely to occur in several alternative paths he may choose.

In short, we really have two pyramids—a pyramid of management and a pyramid of information. These two pyramids can be connected, identifying levels of the management pyramid with levels of the information pyramid. As we go toward the top of each, we find increased focus and fewer elements. There are not many top managers and they do not want to handle vast amounts of information.

Computers have been used in a number of ways in the development of the information triangle. The earliest applications in business and administrative organizations were those which generated and coped with the streams of facts. For example, the first unit of Univac 1 was used in the U.S. Census Bureau for tabulating the extraordinary amount of data collected during the 1950 Census of Population. And the earliest applications in business tended to be essentially of the same type, processing bulk data. Insurance companies were among the earlier users of computers for information systems. The insurance companies cope with a very large volume of premium payments, premium bills, and dividend payments and all the rest of the vast transactions processing which underlies financial accounting in a large insurance company. Thus, the first applications in business and government were for transactions processing. Furthermore, the earliest uses of the computers tended to be for stand-alone applications. For example, in payroll processing, accounts payable, accounts receivable and so on, each application was a separate package and was operated independently from other applications.

During the mid-fifties both information users and information developers increasingly recognized that many of these applications could be brought together as coherent systems rather than as a battery of independent computer applications. That is, users and designers were thinking about systems as opposed to applications. Designers began talking about financial accounting systems rather than payroll, accounts payable and accounts receivable applications. Users also began to shift their focus from what we might call transactions processing for the sake of moving the paper through the organization, to transactions processing for the sake of generating information for management decision making. Thus, by the mid-fifties, these two trends converged: that applications should be grouped together as systems, and that the systems should, as much as possible, generate information for use in the various levels of management.

Perhaps the best illustration of an information system is the modern kind of corporate financial accounting system which brings together information on accounts payable and accounts receivable. This information is built upon the streams of transactions, associated with accounts payable and accounts receivable; the information content of the system is used by corporate treasurers in attempting to synchronize payments and receivables so as to minimize the level of cash held in banks for meeting payments. Cash management becomes the objective of processing accounts payable and accounts receivable; the original objective of pure transactions processing is now subordinate. More effective cash management has permitted corporations to reduce the amount of cash left in banks. The excess cash is invested in short term government bonds and other securities, which provide a corporation with additional income. High interest rates have become an important factor. They provide the opportunity for the use of the cash, while on the other hand, computer-based financial information systems have been crucial in making that opportunity realizable.

At still higher levels, one may think of very highly integrated information systems. Integrated systems bring together several systems. For example, financial systems, production control systems and inventory management systems can be brought together in one large integrated system. And the one integrated system or the one integrated set of systems can take care of port of entry, shipping, inventory, billing, cash management and all the rest.

Government administrators should also attempt to build systems, where feasible, instead of applications. These systems should be integrated where feasible and where the cost is not excessive in relation to benefits; or, better still, where the benefits are large in relation to costs. Any information system has to be built around trade-offs. There is no straightforward formula for building an application, a system, or an integrated set of systems.

There are many dimensions to information systems and designing and building the systems, and it is difficult to make trade-offs on these dimensions. The five paramount dimensions are speed, sureness, scope, sophistication and safety.

Let's take these one at a time. Certainly the speed with which an information system accepts the raw data and generates the information in which we are interested is of crucial importance. Moreover, the speed at which the system responds to inquiry is a crucial dimension of an information system.

The second dimension is sureness, accuracy. Obviously, we want the input data to be as accurate as possible, and we want the whole processing to maintain that accuracy. Accuracy is a constant goal. Yet, here we begin to witness the first trade-off. Sometimes accuracy has to be sacrificed for a great deal of speed or, conversely, where accuracy is the most important objective, we have to be prepared to sacrifice some speed.

The third dimension of an information system is its scope, the extent to which it embraces differing activities of an organization. Now scope and speed can sometimes require a trade-off, the larger the scope the more likely speed will be inhibited. After all, scope applies to very large files and most computer-based systems are slower with very large files than they are with smaller files.

The fourth dimension of an information system is the level of sophistication. Here is a dimension which is relevant to the information pyramid discussed earlier. To generate information that is important to top management requires sophisticated processing and methodology. One of the great strengths of the computer-based information system is its arithmetic computational capability. Just as sophisticated analyses such as simulation or econometric models rely upon advanced mathematics for their methodology, they also rely on advanced computer-based information systems for their achievement.

The fifth and final dimension of an information system deals with the safety of the system. All of us, in private business and in government, are perfectly aware that our files contain information important to the privacy, not only of the firm or the state government, or the federal government, but also of the utmost importance to the privacy of human beings. Safety is, at the present time, the most controversial, and rightly so, dimension of information systems. Now, most of us maintain that we can build into our computer systems no less safety, say, for the privacy of an individual, than is available in manual systems. Whether you crack a file drawer or crack the contents of a magnetic tape, the process is essentially the same. However, it may be possible to devise methods to make cracking the computer tape much more difficult and much more expensive than cracking the locked file drawer. But that oversimplifies the problem. As we bring together increasing amounts of information about individuals, the cracking would yield so much more information than one file drawer that cracking becomes a more worthwhile target. But hedging against cracking costs a great deal. We must walk a difficult line between bringing together so much information in computer-based systems that cracking becomes highly desirable, and developing advanced techniques to minimize the likelihood of successfully cracking a system.

In the end we are going to have a problem with people, if we have any problem. It is not going to be the fact of accessible information that will break down the traditional walls of privacy that we want to protect. It's rather that people will exploit a new opportunity. Recognizing this fact, it is incumbent upon those of us who design computer-based information systems to make every effort either to guarantee the safety of the information inside the system or to persuade management that certain kinds of information should, in fact, not be brought together. We should be honest. If we cannot provide the kinds of safety that the preservation of privacy requires, then we should not bring the information together.

In conclusion, I would like to make a few remarks about the Atomic Energy Commission (AEC) and its management information system. The Atomic Energy Commission is confronted with a very wide range of information and management problems. As the years have gone by, the AEC has realized that information is a many-faceted resource. It must be consciously managed just the way in which people, money and facilities must be managed. And increasingly, at the AEC, we think less of management information and more about information management. In using the expression "information management" we recognize that not only are we attempting to improve the generation of information management, but also attempting to improve our management of the crucial resource that information represents. Since the middle sixties the AEC has been building an integrated transactions processing system. I use the word integrated in the sense of which I spoke of earlier; that is, the various applications are brought together as systems, and the various systems are brought together as one very large coherent interacting whole. The early years of this system have been devoted to integrated transactions processing. This has provided a direction and a framework for the longer run. The integrated transactions processing capability is recognized as the data base for high level information systems and for analytical systems, ultimately to be focused on assisting the highest levels of management.

I should like to conclude my introductory remarks by noting for your consideration that for many, many years it was generally thought that our universe consisted of two all-pervasive components, namely matter and energy. In the age of computer-based information systems which have caused us to reconsider the role of information in our activities, we are recognizing that information is a third all-pervasive component of our universe. Gradually, we are recognizing that our universe consists of matter, energy and information, and information is crucial to mankind because it is information that we use to bridge the gap between us and matter and energy. I counsel you, therefore, as the senior administrators in the state of Montana, to recognize this pervasive role of information, the extremely constructive base that it can be for improved management and improved administration. The development of information systems should be a very serious part of your future!

The Electronic Abacus

JACK J. KEMPNER

A professor of Accounting and Chairman of the Department of Accounting and Finance, University of Montana, Dr. Kempner has been instrumental in introducing and establishing computer and data processing courses in the School of Business at the University of Montana. Before joining the University of Montana Faculty, Dr. Kempner taught at Columbia University, Balboa University, University of Colorado and Ohio State University. He also assisted in Michigan State University's Brazilian Program by instituting a graduate program at the School of Business in Sao Paulo.

JACK J. KEMPNER

The Electronic Abacus

The major interest of state agencies is the application of the computer as an aid in modernizing the flow of information. It is not necessary to know all the electronics involved in designing a computer, nor the mechanics involved in installing and operating one. Fortunately more and more people are being trained to deal effectively with the intricacies of computer technology, and the rest of us can concentrate on devising ways in which the computer can best serve our needs as a tool for processing and analyzing information.

At the same time, all of you will be closely associated with the computer for the rest of your productive lives and may be interested in knowing a little more about how this electronic marvel works. All of us drive automobiles—in other words we make use of a machine without knowing how to build one or how to make any major repairs—yet most of us were interested enough in the automobile to learn something about the principles of an internal combustion engine. I am assuming that most people who are concerned about computer applications in their professional endeavors are also interested in learning something about the fundamental principles of this device. So let me try to tear off the covering of this magic box and explain some of its mysteries.

If any of you have read much about the design of the computer's electronic circuitry, you have probably learned that it follows the concepts of Boolean algebra—then after admitting to yourself that you never heard of Boole—and couldn't care less—you looked at a few of the pictures and then turned on the TV set. Well, not many of us heard of Boole, an English mathematician of the 19th Century, until a few years ago, and although the computer's electronic circuitry is based largely on logical concepts developed by this gentleman, we needn't worry about him or his algebra. It's possible to learn something about the computer without getting involved in higher mathematics or other complications.

Let's start by reviewing some facts we already know. (1) The computer is capable of operating at fantastic speeds and (2) it has the capacity to store and retrieve enormous quantities of data. Citing exact figures concerning its speed or the number of words or characters of information that can be stored would be meaningless because we tend to forget precise statistics anyway—how many of you remember Nixon's exact plurality in the November election? I don't—and furthermore—any figures cited today with respect to the computer would be out-of-date tomorrow.

Light travels at a tremendous speed—186,000 miles per second—at least that's a figure that doesn't change—and operating speeds in the computer are approaching this rate. No wonder it's fast. But forget it—none of us can conceive of these speeds—just take it on faith, it's mighty fast.

Storage capacity is reaching into the billions of characters because of our technical breakthroughs in the development of micro-circuitry. The theologians of the middle ages used to argue about the feasibility of writing the Lord's Prayer on the head of a pin. We're way ahead of them. One computer manufacturer has taken a strip of film—no bigger than an ordinary 35 millimeter color slide—and printed the entire Bible on it—both Old and New Testaments. Again, forget about integrated circuits and micro-circuitry, let the engineers worry about it. Just accept the fact that the computer can store enormous amounts of data within a relatively small space.

In case some of you are beginning to develop an inferiority complex because of the computer's capabilities, let me lift your ego a little. Your 3 pints of human brain—some of us only have a half pint—has more capacity than all of the electronic equipment of the North American Continent. If we built a computer that had the storage capacity of our brain—it would be larger than the state of Texas.

The major components of any computer lie primarily in the storage or memory unit. Even if you are ready to accept on faith the fact that enormous quantities of data can be stored here and that these data can be manipulated at speeds approaching the speed of light—how is it possible to keep track of this information, in what form is it stored, and how can it be retrieved?

I think we should consider first how we can keep track of the data. The heart of a modern computer is its internal memory or core storage which contains the programmed instructions and as much of the data as possible. Each item of datum is stored in a ferrite core (often called a doughnut) and has its own unambiguous address.

Wires are circuited to form a grid at the doughnut, and current passing through these wires magnetizes the core. If the core is at the function of two live wires, it will be activated so that information can be written on the core or read from it; the wires passing through it are both charged with an electric current. These cores are arranged in the form of a matrix. Each column and row in this array is assigned a number so that a particular core may be chosen for selection by referring to its address. For instance, if the selected core is located at address number 22—by sending electrical currents along column 2, row 2, the desired core can be activated—either to read or write information.

Locating a particular core is only part of the job. It is also necessary to convert the electrical energy of the core into meaningful information. The magnetic characteristic of the ferrite core helps us to solve this problem. A core can be in a positive or negatively charged magnetic state. If the current flows in one direction, the core is positive—reverse the electrical flow and it becomes negative. The answer to intelligible information lies in a numbering system that corresponds to a positive or negative electrical charge: 0 or 1. The binary number system—familiar to fourth graders today—solves the problem. While our more common decimal system requires numbers from 0 to 9, the binary system needs only 0 and 1; 0 for the negative magnetic state, 1 for the positive state.

I intend to elaborate further on the binary system but before doing so, let's think again of the matrix arrangement of the core. A single plane can store only a single bit (binary digit) of information, 0 to 1. In order to build up these bits into characters consisting of decimal numbers and alphabetical letters and then words, we must increase the number of planes. Seven planes of core matrices are adequate to handle the letter A. The series of zeros and ones—negative and positive magnetic states—are based on a uniform code built into the machine which signifies the letter A. An actual core unit contains 50 or more planes so that entire words can be read into or out of memory. The method of locating a particular core through its unique address remains the same, but instead of activating a doughnut on a single plane, the cores that bear identical locations on each plane are activated simultaneously.

Another feature of core memory is the ability of the control unit to proceed directly to the desired address without hunting or searching for the information. We refer to this feature as random access capability, a characteristic which enables the computer to attain operating speeds far greater than almost any other form of storage.

No one is quite certain why the present universal numbering system is based on 10. A safe guess is that we have 10 fingers and our primitive ancestors probably counted with their fingers. Some of us still do—nevertheless there is nothing sacred about the number 10.

The computer has only 2 figures—positive and negative magnetic states; so it uses a numbering system that is convenient for a bi-fingered machine. If we look at an array of decimal and binary numbers, we find that in the decimal system, we can write the number 4,148 in two ways: in the conventional manner, or to emphasize its positional value, 1s, 10s, 100s, etc. In the decimal system, each position is 10 times greater than the position at its right. In the binary system—as its name would imply—each position is twice as great as the one on its right—1s, 2s, 4s, 8s, 16s, etc.

Since we are all more accustomed to the decimal system, let's see how this binary system works by relating it to decimal numbers. If you place a 1 in the 1st column, it is equal to the decimal number 1. If you place a 1 in the 2nd column, it is equal to the decimal number 2. There are more sophisticated ways to convert from the decimal to the binary system and back again, but they need not concern us, since the computer is designed to make the conversion automatically.

Note the interesting features of various number systems. The highest integer in a decimal system is 9—in an octal system based on 8, it would be 7. The highest number in a binary system—as you have already seen—is 1 and that is why it is convenient for the computer. The number of integers, O and 1, fit perfectly into the positive and negative characteristics of core memory.

In adding with binary numbers, the principles parallel decimal addition; however, since the highest possible integer is 1 rather than 9, the operator must carry a number in his head whenever the sum exceeds 1. In other words, the operator can't keep adding in his head until the sum reaches 9 before carrying, he must do it after 1. It isn't too difficult to do this sort of thing when adding just two or three rows of numbers, but if the row of numbers exceeds 3 or 4, I wouldn't recommend your trying it. Fortunately the computer does not find it awkward to carry a series of 1s in its "head."

By now it should be evident that large decimal numbers require rather lengthy binary equivalents. For example, the decimal number 86 in the exhibit has a binary equivalent of seven digits, 1010110. The relatively small decimal number 750 would require ten digits. The number 4,148 would take quite a few more digits and the number 50,000 would spread across the room. Although the computer can be designed to handle such cumbersome numbers, space and operating time have been saved by devising a coded binary system instead of *pure* binary as discussed up to now.

Coded binary, more properly called Binary Coded Decimal, uses a set of four binary digits (bits) for each decimal digit and this set of four bits is adequate to represent any decimal number from 0 to 9. Let's see how it works. I will set up four positional columns now instead of an infinite number as before (1, 2, 4, 8, 16, 32, 64, etc.). We will just use columns 1, 2, 4, and 8. The decimal equivalent for 1 would locate a bit in the 1 column as before. For 2, a bit in the 2 column; for 3, bits in the 1 and 2 columns, etc.

Decimal Equiv.	**8**	**4**	**2**	**1**
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

The number 86, for example, would be displayed in the computer as 1000 0110, each four-digit code representing its decimal equivalent. The number 750 would be displayed as: 0111 0101 0000. The number 4,148 would look like this: 0100 0001 0100 1000. As you can see this is a much more tidy arrangement than spreading bits all the way across the page.

One further point needs to be mentioned in connection with the Binary Coded Decimal. Although four bits are adequate for any equivalent decimal number, two additional bits are added in order to symbolize an alphabetical or special character such as a dollar sign. In other words, it is possible to project any number, letter, or special character with six bits.

I mentioned earlier that these binary digits can be coded to represent the letter A. The first four planes of a matrix are the familiar 8, 4, 2, 1, columnar representations—in addition—zones A and B have been added. The first four planes will take care of any number and when combined with zones A and B, any letter or special character can be coded into the computer—and is.

To summarize, core memory represents one of the basic functional areas of the computer. Storage and retrieval of data are practically instantaneous since all manipulation is handled at electronic speeds and location of addresses is obtained through random access techniques. Although we are forced to deal with electrical circuits that are confined to positive or negative states, we have seen how the application of the binary number system overcomes this limitation so that intelligible information can be produced.

It would be ideal if all data used by the computer could be stored in its core memory. However, limitations in the size of the computer as well as the need for economy, have made it mandatory to develop forms of auxiliary storage, which, although slower, are capable of accumulating vast quantities of additional data. Two of the more common auxiliary storage media are the magnetic tapes and magnetic disks. Although the technology differs somewhat from core storage, the same basic form of positive and negative impulses are used and the convenient binary notation again converts electrical energy into meaningful information.

In data stored on magnetic tape, vertical dashes are positive magnetic bits—a blank represents a negative state or zero in the binary code. The data are run along the tape in seven tracks using the 8, 4, 2, 1 number code that we found in core storage and zones A and B to represent letters and/or special characters.

I said that the auxiliary forms of storage are slower than the core. This is certainly true in the case of tape. We do not have the random access capabilities here because information is stored sequentially. It is necessary for the control unit to read or write information on the tape in a pre-selected arrangement—it cannot conveniently search for information in a random fashion. Furthermore, we have introduced mechanical devices when dealing with reels of tape so that we cannot operate in terms of millionths or billionths of a second, as is true in core memory. Nevertheless, the use of magnetic tape permits the processing of information at rates of speed far in excess of any other form of mechanical equipment. I would hardly say we were creeping along when it is possible to read or write data on tape at 300,000 characters per second. The sequential arrangement of information does not present an insurmountable problem either, since many forms of data, such as a payroll, readily lend themselves to such a format. Finally, although we have been forced to sacrifice speed and random access capabilities, we have increased storage capacity. There is practically no limit to the amount of information we can store on tape, and a great number of tape reels can be controlled by the computer simultaneously. Some of the larger installations can control up to 300 reels of tape without human intervention.

The other major form of auxiliary storage is the magnetic disk, a device which combines the advantages of both the core memory and tape. The arrangement of data on the disks permits information to be read or written in a limited random access fashion which expands greatly the amount of storage when compared to the core. Like tape, a great many disks can be controlled by the computer at the same time and additional disks can be filed for later use.

The same binary coded decimal sysem is found in the disk, but instead of storing the data sequentially as in the case of tape, the data are stored in random order and can be located through an unambiguous address system as is true in the core. Instead of the matrix arrangement common to core memory devices, however, the disk is segmented into zones, sectors, and tracks. Modern disk assemblies are arranged in stacks of six and rotate on a common vertical shaft at about 1,500 r.p.m.'s. Read/write access arms extend between each disk and are capable of moving in or out from the center of the disk to the periphery so that data may be transmitted to or from any sector. Speed is of course reduced when compared to core memory since we are again applying mechanical devices. Random access capabilities are also limited since the access arms must wait for the rotating disk to place the desired address immediately over or under the read/write heads.

To review the three major forms of storage: core memory permits the recording and retrieving of data at electronic speeds with uninhibited random access. Cost and storage limitations, however, preclude using core memory as the only form of data storage. Magnetic tape allows for enormous expansion of storage capacity but is slower than core and requires sequential rather than random access. Magnetic disks, on the other hand, are characterized by limited random access coupled with storage capacity and speed that fall between the performance of core and tape. Most modern business-oriented data processing systems adopt a combination of all three forms of storage.

In this very brief talk I hope I have been able to remove some of the aura of mystery that usually surrounds this modern electronic marvel. I have tried to stress its simplicity in an attempt to explain the fundamental concepts of the computer's memory. It would be ridiculous if I were to imply that the computer is a very simple device—not much more involved than an electronically operated abacus. Nothing could be further from the truth; its development required a fantastic amount of human ingenuity and the application of highly sophisticated technological resources. Many individuals have equated the invention of the computer with the development of the wheel as important milestones in man's progress. It is perhaps too early to judge objectively the profound impact that computers will have on our lives and on the lives of future generations; nevertheless, we can be sure that its current and potential influence is enormous.

In the event that some of you are concerned that computers or robots will ultimately control the world, let me allay your fears by reciting a little parody on Joyce Kilmer's classic poem.

I think that I shall never see
A computer made like me;

A me who likes martinis dry
And on the rocks a little rye;

A me who looks at girls and such,
But mostly girls, and very much;

A me who wears an overcoat
And likes a risque anecdote;

A me who taps his foot and grins
Whenever dixieland begins.

They make computers for a fee
But only moms can make a me.

Characteristics of Successful Computer-Based Information Systems

MARVIN W. EHLERS

Mr. Ehlers has been involved in a wide variety of computer applications since 1958. Presently, as Executive Vice-President of Ehlers, Maremont and Company, he is responsible for professional staff activities of the firm including consulting, analysis and programming. Prior to his association with Ehlers, Maremont and Company, Mr. Ehlers held positions with C-E-I-R, Inc., Beckman Instruments, Inc. and the U.S. Air Force.

MARVIN W. EHLERS

Characteristics of Successful Computer-Based Information Systems

While my title was to be The Characteristics of Computer-Based Information Systems, I have added the term *successful* for a very important reason. If I talked about the characteristics of all our data processing installations, it might seem more like a chamber of horrors than a success story. Unfortunately, this new technology—it is still relatively new—has far outstepped our ability to use and control it. Manufacturers talk about third and fourth generation equipment. I seriously doubt whether we have yet learned how to use the second generation equipment. We have a lot to learn. We are bewildered at what we perceive to be a complex situation, when in reality some good old fashioned, proven management techniques are easily applicable.

Before I talk about some of the system characteristics, I want to issue a disclaimer—information systems need not include computers. Information systems, if they do include computers—and obviously they do in most cases—extend far beyond the walls of the computer room. They pervade the organization. You must realize this, and do not conceive the information system to be a limited, isolated, "blackbox" function included in an organizational chart. The information system has tentacles reaching into every part of the organization. As Mr. Herb Schwartz pointed out earlier, the system is increasing in complexity and degree of integration every day, and unless you guard yourself with the proper mental perspective, you will be surprised.

The first characteristic of a successful information system is the ability to properly define the problem—or problems—to be solved by the resultant information system. Can you define your problem(s)? In a majority of cases a potential user does not know how to define his problem or how to discuss it with a data processing staff. It is not enough to say "develop a personnel system" or "I want a state license system." This simple direction does not tell the data processing staff what is really needed. Several elements contribute to defining a problem. The most important—and the beginning—is to identify the objectives that must be achieved. I suggest writing them down because human memory is extremely volatile and because the effort of writing helps to bring thoughts into some kind of order.

In our organization we use a hierarchy of definitions, and broad objectives are at the top. These are further defined by identifying specific goals. This differentiation is necessary because goals should be capable of being specifically defined and measurable, both in terms of time and value. With defined goals, one can measure quantitatively and therefore not have to depend on somebody's estimates as to achievement.

In any given problem there are constraints; they may be legal or purely logistical. They may involve time, money or budget procedures. Even the method of solving a problem could be a constraint. These constraints plus our goals, available resources and appropriate "ground rules" must constitute the definition of the problem. And a hierarchical arrangement of goals must exist within this definition of the problem. At the top of the list of goals are those which you must produce—or there is no justification for the information system. Beyond these—in descending order of priority (and value)—are other goals of the information system.

A responsible user must then present this value structure to system designers to provide them with a basis for designing an effective system. One should be very careful in designing information systems in order to allow for their expanding scope. But one must also "limit the scope of the project." These two statements are quite compatible. You can limit the scope of a project, realizing at the same time that the segment of work must fit into a larger pattern of things. The statement, "limit the scope" means limit the size of the project with respect to both time and required resources. As an example, a small firm in Chicago invested three-quarters of a million dollars in an information system of a particular type. Unfortunately, their goals were too high and the project too ambitious for their resources. Given five million dollars, they probably would have succeeded. Presently, they are going bankrupt and have little to show for their money and effort. It is in this sense that I use the statement, "limit the scope of the project." Another facet of this characteristic is the consideration of how we approach a problem. Is it not reasonable to treat the initial investigation as though it were an R & D activity? Large firms are beginning to follow this procedure and I think it is the appropriate thing for government to do.

The second and one of the most important characteristics of successful information systems is communication. Often because of the technical jargon used by engineers and technicians, the communication between tiers of management tends to break down, causing ineffective operation of the system.

Communication is a people problem. The worst communication problem exists between the central users and the management information system technicians. Ideas must be transmitted from the user to the technician if we are to have an effective system and retain control of it. Part of the problem stems from the tunnel vision of the technicians. As a part-time technician, I can make the statement that technicians in our industry tend to be more concerned with their professional status and latest techniques, than with solving management information problems. The user must realize this bias and insure that he gets full value for his investment.

The third characteristic is an obvious one. A successful system must be economical. The word "economical," of course, is a general term having to do with the value of the information. Part of this value lies in the reduction of uncertainty. For example, if I have some degree of uncertainty and if some data arrives which reduces my uncertainty, it is information. What value is that information? The *user* must be able to put a value on it. If he assigns someone else to do this task, he is abdicating an important responsibility.

Typically in more conservative organizations, the initial justification is displaced cost. How many people are going to be displaced or changed? In most installations, however, if everything depended on displaced cost, few things would be done with a computer. Here again, it is the value concept. What is it worth to be able to give better service? For example, what is it worth to be able to put stolen vehicles on a random access system so that any law enforcement agency in the state or country can use that information? What is it worth to be able to inquire into driver's license status on a real-time basis? The user must not only assess the value of this information but also deal with the problem of cost. Unfortunately, costs vary in the design and operational stages of a system. In the data processing function, there is a large fixed cost which is very easy to determine. Overhead costs, however, tend also to be fairly large and they require some procedures for allocation among departments. Therefore, it is imperative for the user to be thoroughly familiar with the data processing functions of his organization to determine how costs are presently assessed and charged both in the implementation and operation stages and how they could be in an operating system.

In the area of economics there also exists the problem of estimating future costs and benefits. In economic terms, future values have to be estimated. This task also belongs to the user—not the technicians.

Another important characteristic is flexibility —now and in the future. If the system is to remain functional, this characteristic must be included in its design. The system should be flexible enough to accommodate ever-changing needs. However, it should be clearly understood that providing a system for later changes adds to current expense.

Ideally, it would be desirable to have a system with no errors, but unfortunately errors do occur. To take care of this problem some acceptable level of error, along with modes of detection, identification and correction should be established. For example, people transmit wrong information, fill in blanks incorrectly, and key punch operators cannot read some handwriting. These types of occurrences are common and the mechanics for correcting such errors must be considered in the basic design. It was in this vein that I made my earlier comment about information systems extending far beyond the computer room walls. Above all, the system design should reflect an educational characteristic; we need to educate the people who are generating and using data. They should be emotionally involved and understand their part in the total system. This job of education tends to be a continuing one because of the constant turnover of personnel.

Another characteristic is the capability of responding quickly and immediately to information requests. How quickly depends upon the context of the system used. In the case of a file on a stolen vehicle, obviously the response time should be in seconds, whereas in another situation, with another system, the response time could be overnight or next week. Response time in terms of a few seconds costs a great deal more than the response time of next week. The user, again, must assess the value of the shorter response time and include it in his problem definition.

Security of the system is the next characteristic of a successful information system. By security, I am referring to restrictions on access to the data and the ability to change the data. This topic becomes more sensitive as more information is put into the system and more personnel are given access to the information. Unauthorized access is more serious when the information concerns individuals. The user should not only be cognizant of this problem but should analyze the sensitivity of the data and make proper decisions to protect it. This again should be a vital part of the definition problem.

Reliability of the overall system is another characteristic, but this should not be confused with the error-free concept mentioned earlier. Reliability is concerned with the hardware facilities; and since these are machines, they break down. The user should be concerned with this problem. What provisions have been made to protect the files so that they could be reconstructed? Can the data be accurately retrieved or recovered? Some businesses become so dependent on their machines they suffer unduly when they break down. A case in point is the experience of a west-coast airline which suffered serious loss in business due to a malfunction of their computer. Checks and balances should be built into the system to warn users about system failures. For some functions such as accounting, audit trails should be built into the system and these controls should be included in the problem definition.

All these things should be taken into consideration before planning an information system. Remember, they are primarily management considerations, and not technical ones. Do not attempt to be pioneers. Do not be first to use a new technique, new equipment or a new piece of software. The risks are substantial. Technicians, with their fondness for new technology and innovation, may sell you a bill of goods. It is sometimes hard to do, but defend yourselves. Before making decisions, have an independent technical staff review the recommendations.

An old philosophy on systems and procedures is the "Kiss Principle" (keep it simple stupid). We often tend to go in the opposite direction and delight in the complexity of the situation. Make the system easy to use, easy to teach, and easy to understand. It takes more design work to acomplish, but it is considerably cheaper to do it now than to suffer the inefficiency of the entire system later. Typically, because of the constraints such as a tight budget, fringe items are eliminated, making the present easier, but the future harder to live with. Understand the operation and realize the values and costs associated with it—now and in the future.

When the design and installation are completed, make sure they are well documented. Documentation is an extremely important characteristic of a successful system. When future changes are needed in the system, the people who designed and programmed the system may be gone; the normal turnover for programmers or system people is around 18 months. Often these people have a great dedication for technology, which may be fine for them, but not for the organization. If they leave the organization, they take with them all the valuable knowledge that you paid for. Therefore, prepare detailed specifications on the system in exactly the same manner as an architect makes detailed drawings and specifications for a building.

Another important characteristic is the social and political acceptability of a system. If you are trying to promote a concept that is simply not acceptable, then you are probably trying to accomplish the impossible.

All the characteristics I enumerated are appropriate for any application. There are no good rules of thumb to pinpoint a logical place to apply the computer. Generally, if there is an extremely large volume of data which can be readily defined, and if the data are being handled by a large number of persons, then a computer application may be feasible. Once again, there are values to assign to all these characteristics and that decision belongs to the potential user.

Overlying all these characteristics is the broad concept of management. Efficient management demands planning, and in this area planning cannot be overemphasized. Many businesses go into data processing without proper planning and later suffer the consequences. There are a lot of decisions that have to be made by management. Decisions concern trade-offs: quality, time and cost. There are value structures that constitute a scoring for these trade-offs. In many cases there is not enough information available to make the trade-off decisions; and once again, it is the user who should do the analysis and make the decision.

After the decision is made to use electronic data processing, the next step is to develop a work plan, in terms of specific goals you want to achieve. The work plan should be broken into tasks. Depending upon the needs—resources, personnel, etc.—a schedule should then be made. For instance, although the conversion of a master file to some sensible machine form is the biggest task, this may not be needed until well into the system development. Then there are other questions which should be answered. Who is responsible for providing the resources? How flexible is the budget? The budget does not necessarily have to be a formal one, but certainly something with which to compare performance.

In summary, let me briefly define the sequence of the project, as I view it. The first step is to define the problem in writing and get an agreement on it. The second step is the conceptual design—an architectural sketch, if I may use that analogy again. There may be more than one conceptual design. Evaluate them, but do not start implementing them yet.

Typically, the next step is the detailed design stage. This is the "engineering" part. Here again questions should be answered such as: How is the data going to be edited? What about errors and corrections? How many copies of the printouts? Where do they go?

At this point we usually go through what is called "the bloody thumbprint procedure" which is still analagous with the work of an architect. The architect presents his client with the design, and says, "Here is the job we have designed, do you agree and accept it?" If they both agree, the contract is signed. The same idea should be applied to the information system design and a "bloody thumbprint" placed on every document associated with the design. Users typically raise the objection that they do not understand the design, or that they do not have time to study it. The user has to understand it to make decisions; and, if he does not, he is simply abdicating his responsibility.

Implementation follows the design stage. Money has been spent on planning and construction; the system should now be implemented and tested to satisfy the user. Assuming that we have the "bloody thumbprints" on our documentation, we go into the actual writing and testing of programs and more documentation before final approval. In this final testing, I suggest that there is another characteristic we should pay attention to—that is, testing of the final product in some reasonable way before accepting it. I like to have a client satisfied and know that what I have done is what he asked for. All too often the user has supposed or just accepted the fact that the data processing people would do the testing and turn it over and say, "Here it is!" I don't think this is good practice. The user must be deeply involved in defining the test procedures; in fact, they should be defined at the detailed design stage. You want to test those functions that went into the detailed design. Your personnel and representatives should be directly involved in the design and execution of the acceptance test. Most manufacturers and even the government set up an acceptance criteria when the contract is signed, and before payment is made the installer has to meet that acceptance test criteria conducted under their supervision. I do not know if the supposed complexity of the whole thing is what scares people but let us apply good management principles.

Early definition of the responsibility and authority of various people involved in data processing projects is another item which should always be kept in mind. Whenever we set up a project we want to make certain that there is a key individual in each group who is responsible for the proper conduct of the project. Also, make the penalty for failures explicit in the initial definition. What happens if the system fails or fails in part? You want an escape hatch along the way and I think it is perfectly reasonable to ask this. How do you recover from a project that is half done? You should give that some thought.

Another problem—it is not really a characteristic, but a warning—make certain that you understand how priorities are determined in the data processing organization. I suggest that you have an appreciation of how your project stands in terms of these priorities and who makes the decisions regarding priorities. One other comment regarding the effect of systems on organizational structure: the effects are becoming more pronounced all the time and I have only one word of wisdom on this topic: discipline. We must establish and enforce procedures and standards in all activities associated with the development and operation of an information system, if we are ever to realize the full benefit of this powerful technology. We must, in short, establish a discipline for ourselves.

Computer-Based Statewide Information Systems

DONALD D. SCRIVEN

Dr. Scriven, Director of Missouri's Administrative Services Agency is on leave from Missouri State College, where he is a Professor of Economics. Dr. Scriven possesses extensive experience as an advisor and consultant, and prior to his present position, he had been an advisor to Missouri's "Little Hoover" Commission and the Commission on Higher Education.

DONALD D. SCRIVEN

Computer-Based Statewide Information Systems

Read any recently published advice on management, and you will be inundated with buzz words. Among the most popular buzz phrases is, "management information systems." Can we manage without one? Probably, but not very well.

I remember one of my better bosses. He used to come by my office regularly and ask, "What's new?" It didn't take long for me to learn that my, "Nothing much," ended the visit in a matter of seconds. On the other hand a mysterious, "Well, you may want to know about something that happened yetserday," always resulted in a cup of coffee with the boss. The prestige of having coffee with the chief often was greater than the value of my news. But the boss always listened attentively. He never dismissed any information as unimportant; and I soon learned the two subjects that interested him most: budget and personnel. My desk wasn't the only stop in this information system. The boss had a regular route with very predictable stops. In fact, employees soon learned that a few words in the right place found their way to the boss in a short time.

This was a primitive management information system—no expensive machines—but it worked well. This system did two things: (1) it kept the boss well informed about his organization; and (2) it allowed many middle-level managers and employees to participate in running the organization. The modern management information system retains the same ingredients as its predecessor. However, larger organizations with more employees require a faster, more comprehensive system. Information is still directed to the chief executive for his use in managing.

The term "system" has about as many definitions as there are organizations. It is safe to limit our discussion of information systems to a set of procedures that accomplish any stated purpose or function. Systems need to be controlled so they serve the chief executive. Most chief executives will tolerate only those systems that help him prosecute the goals of the organization.

Consider how a modern information system would serve my old boss. He felt the functions of budget and personnel are the most important elements of a successful operation; and control of these two primary functions must be in the hands of the chief executive. These two functions are supported by a number of systems. The budget function is supported by an accounting system, a finance system, and a property system. The personnel function is supported by a recruiting-advancement system, a distribution system and a production system. All systems require records in order that executives at various organizational levels may monitor the adequacy of each system. Each system is required to contribute to the total goal of the organization in some fashion.

Control of the six systems enumerated is similar to the control of any procedure. There are basically three requirements in order that any one of the systems may be controlled:

1. there must be stated goals for each system;
2. there must be a unit of measurement for system operation; and
3. there must be provisions for monitoring the operation of each system.

Most systems in modern organizations fail to establish goals for themselves. The absence of a stated goal for each system probably means that a system will not contribute to organizational productivity. It is quite simple to devise parameters for a system within an organizational structure. However, if a system does not contribute to the organization's total goal, then the system will soon find itself faltering and eventually eliminated. This particular phenomenon accounts for the fact that a stated system may be an essential and required part of one organizational operation, while a sister organization may function rather well without such a system.

Stating the goal for each system is usually the responsibility of the organization's chief executive. The chief executive may ask for the advice of his staff and other executives responsible for operating a particular system. There should be clearly stated goals for each system as well as a procedure for reviewing these goals periodically. It is not sufficient to establish a system and allow it to operate indefinitely without a critical review by the organization's executive staff. Such a review of system goals is necessary in order that each system remain absolutely responsive to the changing goals of a dynamic organization.

It is difficult to prescribe a unit of measurement that can be applied to the operation of each system. Some systems are so traditional that units of measurement can be identified with ease. However, other systems are so new and complex that units of measurement commonly defy definition. Since the study of systems is relatively new, we can expect to find many systems in any organization that have poor or inadequate units of measurement applied to systems operation. This is not to be regarded as a failure of the organization to solve the problem of unit measurement. However, each organization should be aware that units of system measurement are often difficult to define; therefore, there should be a provision for the constant reassessment of units of measurement.

The common unit of measurement used in organizations today is the dollar. It is suspected that the dollar is often not a desirable unit of measurement; but rather, the digits express a decimal figure representing a quantitative evaluation. In other words, removing the dollar sign would probably provide a very adequate unit of system measurement in terms that are easily understood. The derivation of a meaningful measurement unit for each system is not easy. The accounting system probably is the best example of a system with units of measurement stated in dollars.

Monitoring system operation is commonly achieved by regular reporting. These reports generally cover prescribed periods of time, and in an accounting system the reports correspond to the fiscal periods established by the organization. Chief executives commonly require additional reports that give summarized information from other systems. Such reports from a personnel system show the rate of employee turnover as well as significant statistics regarding terminations, absenteeism, work audits, and employee evaluation.

Reports from the distribution system commonly show salesmen efficiency as well as total effectiveness of distribution. Reports from the distribution system are commonly expressed in terms of dollars—a unit of measurement easily understood in the distribution system. Some organizations require regular distribution reports, and other organizations require distribution reports only when critical benchmarks are reached. These critical benchmarks generally involve a substandard distribution that signals organizational net loss, or a high distribution may signal a level beyond production capacity.

Monitoring the finance and property systems generally involves annual reports. Organizations often prepare these reports only for stockholders meetings rather than for the use of management.

Production reporting varies among organizations. Detailed production reports have not generally been given to chief executives, unless critical production dates were missed. The increasing number of critical production dates imposed by U.S. Government contracts has made many more chief executives aware of production schedules than during previous decades. These critical production dates have caused such management techniques as Program Evaluation Review Technique (PERT) and Critical Path Method (CPM) to arise. Both management techniques require regular reports from the production system. We find that the techniques applied to the production system along with the regular reporting are also applicable to other systems that must meet critical deadlines.

It is possible to examine one of the more structured, older systems common to every organization as an example. This is the accounting system, and it is characterized by having well defined goals, a well defined and well understood unit of measurement, and established procedures for monitoring the system.

The following are generally identified as the goals of the accounting system:

1. summarization of income
2. description of asset growth
3. summarization of expenses
4. supporting tax reports
5. supporting stockholder reports

6. reporting the effectiveness of operating units
7. reporting the efficiency of operating units
8. reporting money management
9. predictions

These are commonly understood as the goals of any accounting system, and these goals are part of an established discipline in schools of accountancy. The longevity of the accounting discipline is responsible for the common understanding of this system. Practically all executives at various organizational levels have been exposed to the discipline of accounting, so these goals are readily understood and expected as a product of the accounting system.

The unit of measurement in the accounting system is the dollar. Even though the dollar sign may not be important for some reports, it is a commonly understood numerical unit. Because of the common understanding afforded this unit of measurement, the system's operation is easily understood by executives within the reporting organization and by executives from other organizations.

The monitoring of the accounting system is provided by monthly or weekly reports. Quarterly and annual reports are not as common for internal control as for providing external information. The monitoring function has been enhanced by the availability of computers and the resulting printed material. Some organizations find that prepared booklets are a necessary part of the monitoring system. At any rate, the effectiveness of the accounting system is easily understood through the reports that comprise the monitoring segment. Executives understand the accounting system so well that they may vary the regularity of monitoring reports without damaging the system.

The institutionalization of the accounting system has resulted in a unique organizational structure that can be found, formally or informally, in practically every organization chart. This organizational chart generally represents the comptroller or the organization's accounting system answering directly to the chief executive; in most cases, the accounting system is an intermediary between the other systems and the chief executive. The high regard held for the accounting function is generally proven by the close rapport established between the chief executive and the comptroller. In many cases this rapport is so intense and so close that the removal of the chief executive places the operation of the organization in the hands of the comptroller. The comptroller may, in fact, operate the organization while the chief executive is present in the organization. On the other hand, the comptroller is often the logical choice as the new chief executive, when a chief executive has been removed or leaves the organization.

Since all other systems become subordinate to the accounting system, a problem arises in the organizational structure. This subordination is by default, probably because the accounting system is much more highly structured and more easily understood than are the other systems necessary to support the chief executive. The subordination of other systems to the accounting system are characterized by a pre-audit function, which is guarded jealously by the accounting system. The pre-audit function requires every other system to sublimate its initiative in efficiency and operation to the will of the accounting system or the budget. There is seldom any consideration as to whether any of the other systems should be subordinate to the accounting system. There is the assumption that all such systems are subordinate.

The control given the accounting system by such a function as the pre-audit tool usually cannot be tolerated long by a chief executive, who wants all his systems to give him unbiased information. The subordination of the finance, personnel, property, distribution, and production system to the accounting system places too much power in the accounting system. Farsighted chief executives recognize the accounting system as one to be equal but not superior to other systems necessary for operation of the organization.

The subject, "systems control," raises two questions:

1. Shall the chief executive prescribe the systems that give him adequate information, which allows him to control the organization? or
2. Shall the chief executive accept existing, institutionalized systems that control the organization, when such systems report to the chief executive on the effects and efficiency of such control?

Either approach may result in a successful organizational operation, provided a conscious chief executive is selected.

Information systems needed to support public administration do not differ markedly from those used in the private sector. The chief executive needs information related to his programs and policies. Today's government executives must provide adequate housing, health facilities and services, transportation, educational facilities and services, a dynamic economic base, and public safety.

Since these goals are easily identifiable, a government information system should evaluate the progress and problems related to each goal. The major functions commanding the chief executive's attention may still be classified as those related to budget and personnel. However, a government information system should emphasize a broadening of the term "personnel" to include citizens as well as government employees.

In order to make our discussion compatible with the discipline of political science, we will classify all budget related matters as "fiscal systems;" and all personnel matters will be treated as "people systems." Fiscal systems serve the chief executive by predicting revenue and cash flow. These systems can provide encumbrance and expenditure accounting while automatically generating budget data and performance information. People systems must serve the staffing function of government administration; and these systems must also handle information related to the problems of citizens.

People systems should provide data that reveal the adequacy of existing housing as well as the need for future housing. Solutions to current housing problems require information such as: (1) family size and ages of members; (2) parking space required; (3) access space required; and (4) housing for services related to families.

Information related to the "housing" classification may include family-related functions like manufacturing, education, distribution, professional services and storage. Government provided services and area required for public utilities may also be related to families and housing.

Government must solve health problems which cannot be dealt with by individual citizens. It is essential that the information system monitor health conditions as well as potential health hazards. Traditional health information has ignored mass data on dental problems, nutrition and emotional stress. A modern health information system must include these types of data along with the usual data. Health data must predict health problems, and pinpoint these problems geographically.

Existing educational systems seemed designed solely for the educational community. These systems must be expanded to serve government in forming public policy. For example, the economic development policy of a government should cause the educators to develop the proper mix of vocational, technical, scientific and cultural education to attain the prescribed economic goal.

An adequate information system can predict the resources necessary to support the educators. However, the system's data need only indicate geographical locations as focal points for information summaries—data on individuals may remain in schools. Since the system concentrates on geographical locations rather than upon individuals, it will be possible to relate educational status to the requirements for the labor force. Educational inadequacies should trigger corrective school programs. Such programs will serve adults as well as children—a new concept for educational information systems.

Government has historically provided or regulated transportation. The stated goal is to move people and goods from one point to another. Information systems monitoring this government function should be designed to predict locations for transportation bottlenecks as well as provide an array of alternate solutions.

Unfortunately, government is usually organized to serve individual methods of transportation such as railroads, highways and aircraft. A proper information system will reflect the needs of people in discrete geographical locations. The system should also suggest a mix of all transportation methods that may be used to provide the necessary services.

Economic health depends upon the economic welfare of society and individuals. Information required for evaluating the economic health of society may be obtained by summarizing business activity throughout several smaller political subdivisions. This information is well defined, since the federal government has developed a rather sophisticated data series that leads to economic indicators. A significant portion of the proposed economic information system should show economic inter-relationships among industries. Personal economic data relating to family real income, spending and saving habits is important in predicting citizens' welfare.

The exact blueprint for a governmental information system will vary with the political subdivision. The variance will reflect geographical and environmental differences as well as different philosophies of government. These differences will cause the arrangement of data within the information system to be different; however, there is probably a common data base that is needed to provide an adequate information system for all political subdivisions. The data base consists of specific information as well as a common index for filing that information. The basic file structure utilizes a building block or basic unit for data collection. There is much to recommend using a land parcel as the basic unit of data collection.

A land parcel may be assigned a discrete number that will identify the particular geographic location until that particular land parcel changes its physical description. Physical changes in the land parcel are commonly noted as subdivisions; index numbers may be arranged so that subdivisions may be traced back to original land parcels. Land parcels are convenient units for data collection, since data filed under the land parcel number may be sorted in any number of manners. For purposes of our discussion, a land parcel may be defined as follows: an individually owned single unit existing within one section of land—a section being a 640 acre square.

While this definition of a land parcel may be different from that used by some assessors and surveyors, it adequately meets the needs of an information system. The information system may use only a part of the stored information at any one time. However, some models use all of the information relating to that particular land parcel.

One advantage in using land parcels as the data base involves eliminating the objection many citizens have to personal confidentiality. Another popular data base building block is a person or individual. Most of us recognize that when individuals are used as indices in information systems, it is possible to encroach upon confidential information. Using a land parcel as the index base eliminates this particular problem; however, the information system can still produce data summaries that are very useful in addressing the problems of today's societies.

It is possible to focus upon problems in society as they are related to land parcels. For example, a concentration of unemployed persons may be related to a single land parcel or a group of related land parcels. Experience in urban centers indicates that single land parcels containing multi-story apartment complexes are often geographical centers for unemployment as well as health and welfare problems. Locating these problem centers by land parcel is just as useful as locating individuals who are unemployed or who lack health care. In fact, the focus of solutions to such problems seems to be drawn more easily toward geographical centers than toward individuals who may be scattered throughout the urban area. Citizens usually visit their home base at some time during the day and it is convenient to treat the home base or home land parcel as the center of social problems.

An additional advantage to using land parcels as the data base accrues from relating local data to that accumulated by the U.S. Bureau of the Census. Data summaries may be related to similar data summaries from the Bureau of the Census making it possible for the information system to relate current problems in one geographical area with problems in similar environments throughout the United States. These comparisons are quite useful in denoting progress or in calling attention to areas in which social problems may occur.

The information system we envision addresses such social problems as health, unemployment, transportation, housing and education. It is possible to expand the data record for each land parcel so that information relating to other social problems may be included. However, some caution must be exercised so that the data record for each land parcel does not become burdensome in length. An alternative to a single data record may be fragmenting the data record with adequate cross-indexing that use land parcel numbers.

The information system built around the land parcel file may be used for any political subdivision changes. Some states are quick to admit that the county boundaries existing today may be changed in the future—there may be a consolidation of several counties into one region. We find the same sort of consolidation in urban areas and their fringe communities. The consolidation of counties, or cities and towns into larger units will naturally cause the political subdivision boundaries to be redrawn. A data base built around land parcels need not be changed in order that the information system be adjusted to fit new political subdivision boundaries. Simple changes in sorting programs will accommodate new political subdivision boundaries while the basic land parcel records remain constant.

The proposed information system contains data primarily of interest to government agencies. However, there has been considerable interest shown by private enterprise in this particular type of data system, with a possibility that the needs of private enterprise may cause the data record to be expanded. However, information such as personal income, educational achievement, transportation methods and similar data related to the land parcel are invaluable to private enterprise operations. Private enterprise uses such data to plan the future demand for services and goods as well as in predicting consumer market depth and labor supply. While this information is of primary interest to private enterprise, the same information is quite helpful to communities seeking industrial development.

Several simulation models have been developed to use the data base that is proposed. Three models that are important to government agencies involve population changes, an economic index and unemployment. The population change model is triggered by regular census activity. The census activity denotes a change in the population and this in turn tells the governing agency that changes are necessary in land use. One commonly recognized change in population will be a change in average family size. Naturally this change in average family size can come from an increase in population of existing families or because methods of calculating actual increase in population will also result in noticeable changes in the model.

The automatic indicators in population point to changes in land use. The land use model relates all land use to a land parcel that is built around a living unit. When the number of people increases to the established parameters, the land use model automatically indicates the number of acres that will be needed to adequately provide dwellings, recreation areas, service industries, professional services, manufacturing, parking, recreation, education and governmental services to the population. The parameters for these provisions may be established policy of the governing agency. A change in policies will automatically change parameters, but the information system together with the population use model may remain intact.

Another useful model is the economic index which relates income tax withheld to state and federal expenditures and transfers within an area. When these are aggregated through the information system into a political subdivision summary, then certain inferences may be drawn concerning economic health of the area. It is particularly useful to relate the economic index to changes in the population model.

Another quite useful model is the unemployment model. This model collects unemployment statistics from individuals; however, these personal data are filed by street address or land parcel number. The individuals are classified according to the job categories recognized by state and federal employment agencies. The incidence of unemployment insurance claims are aggregated and related to all other known, unemployed individuals in the same skill group. The total unemployed in each skill group is then related to a parameter that is considered to be critically high for unemployment.

This parameter or unemployment policy may be established by the governmental authorities and it may change as government policy is modified. At least two conclusions may be drawn from the information system's automatic generation of unemployment data: (1) the information system may indicate a skill area as well as geographical areas that are in need of corrective rehabilitation-education programs to return unemployed individuals to some productive capacity in our system. This type of rehabilitation-education program may exist in the form of retraining for a higher level skill or retraining to enter a completely unrelated skill; and (2) the unemployment model may also indicate areas in which unemployment incidence is beginning to approach critical parameters. In this case, rehabilitation-education programs may be generated in geographical areas having the highest incidence of unemployment even though that unemployment level is not yet critical.

The same unemployment data may also indicate rehabilitation-education programs that are needed in other geographical areas where large numbers of people work in similar or related skills. The information system makes possible several deductions concerning the provision of continuous employment for skilled employees.

We in Missouri have developed a population information model, a health information model, and an unemployment model; and the data for these are collected and monitored regularly. We now have the backbone of a very specialized system and we hope to generalize it in the near future. In conclusion, let me point out that you must make a start; and until you take the big step of initiating an information system you will not fully grasp the essence of such a system.

Experiences with a Statewide Data Processing Program

CARL W. VORLANDER

Mr. Vorlander, Administrator of the Division of Financial Operations for the State of Wisconsin, directs the activities of the Bureaus of Municipal Audits, Finance, Systems and Data Processing. A graduate of the University of Minnesota, Mr. Vorlander began his career in the field of public administration and accounting; subsequently he became the Director of Minnesota's Resource and Planning Department. In 1960, he joined Wisconsin's Department of Administration as Assistant Director of the Bureau of Management and became the Director of Systems and Data Processing in 1963. He is responsible for the first full-scale feasibility study concerning the use of high-speed data processing equipment by state governments.

CARL W. VORLANDER

Experiences With a Statewide Data Processing Program

My topic, as the title suggests, concerns the nuts and bolts of state data processing. There are a number of alternative ways of organizing and staffing for data processing purposes, but basically the alternatives range from a completely centralized to a completely decentralized approach. Both have their advantages and disadvantages.

Under the centralized approach there is one service agency; it owns all the equipment and does all of the data processing that is required by the state. Typically, a centralized operation utilizes the equipment during three eight-hour shifts and the system analysts and programmers rarely have any idle time. It is possible, under a centralized operation, to achieve absolute uniformity because only one agency is doing the work and operating the equipment. The fully centralized operation—although I am not sure that there is one in the 50 states—would have tremendous scheduling problems. During a peak period a user needing urgent information would not be able to get it if the center was tied up and this would leave a bad taste in the mouth of the user. At the same time it may create input preparation problems which would force the centralized agency, during peak periods, to have the user department prepare the input. This may prove an advantage if the user then becomes acquainted with the problems of the centralized agency: there is nothing that will cure the bad penmanship of the game warden taking a creel census in a rainstorm faster than having to ask his own department to key punch that information. If the same work was done by someone in the service agency, the errors could always be blamed on the center and not the user agency. Another problem of a centralized approach is department distrust. Users tend to be reluctant when it comes to entrusting another agency to process their information.

A decentralized approach, on the other hand, finds each user with its own equipment, staff and complete freedom to operate as it sees fit. Scheduling problems are eliminated because one administrative head can determine the priority of jobs. Furthermore, decentralization seems to create departmental trust. There is a great deal of satisfaction from saying, "that is my equipment, my staff, my program and I do not have to worry about what is being done."

Wisconsin has chosen a combination of these two approaches; there is a central service agency for many, if not most, of the user departments, but those agencies which have realistic justification still maintain their own equipment and personnel. In my opinion, this approach is reasonably efficient even though the workload varies. For example, February through June finds us concentrating on tax returns; during June and July, or July and August, we complete the revenue-sharing reports; during September we provide the bulk of our services to the educational department; and November is a relatively slack period. Such slack periods may occur, but overall reasonable efficiency can be achieved. Uniformity is also possible if there is a definite statement of purpose on the part of the administration and there are no insurmountable scheduling problems. Our normal turnaround time for an unscheduled job is 24 hours. Our equipment is compatible because we have a central coordinating function; this also makes considerable data exchange among the various users possible.

Perhaps more important than giving an over-view of our current status would be for me to explain the process we went through to establish this combination approach. Prior to 1960 many state departments in Wisconsin had their own computer installation. At that time a task force recommended that all of these operations should be combined; someone else seconded the motion, and with no preplanning or scheduling seven data processing departments were literally combined—they were put into one room. We had eleven 407 accounting machines sitting in that room and we called it a central shop.

You can imagine the chaos. There was no documentation about departmental applications, costs or responsibilities. Consequently, there was no staff or functional centralization: the man from Agriculture stood by his machine and processed agricultural jobs; the Conservation Department man ran conservation jobs on his machine and so on; and two others read magazines.

All this changed abruptly when the 1961 Legislative Session saw a general sales and withholding tax bill passed late in December; the bill was to become effective on February 1, 1962. To process the results of this bill the Department of Administration ordered a computer on January 4, installed it on February 20 and processed the first returns on February 25—a classic example of how *not* to begin a centralized data processing system. To emphasize that point, let me give you a few examples of what happened: we never ran the same job in the same manner for two consecutive months. One poor citizen received 10,000 tax returns in seven mailbags; and since we were using continuous card forms we had to shuttle back and forth across town to use the telephone company's burster. We also wrote a $2 million check for a salvaged auto valued at $2, and so on.

After three months the workload declined enough so that we could sit down and examine our data processing department. Needless to say, we realized that our work was a far cry from an effective and efficient operation, but this realization did not make the improvements automatic. Wisconsin went through the following steps to make those improvements a reality.

First, and most importantly, we secured the full support of the state's administrators. I cannot begin to emphasize the importance of this first step: without the support of the governor and his staff, any centralized data processing department is in real trouble.

Secondly, we hired a consultant—he came from Chicago, more than 100 miles from our office so he was an expert—and together with the governor and the department heads, we explored the advantages and disadvantages of a partially centralized operation. Based on these discussions and a review of the task force statements referred to earlier, we prepared a written policy which basically described how data processing would be handled in Wisconsin; that policy statement was enunciated to all department heads.

Thirdly, we prepared a time-phase analysis for merging all of the separate data processing departments, their equipment and personnel. Supplemental to this analysis, we determined an equitable billing formula for departmental work and a priority schedule for job processing. Our billing rate takes into account the average utilization of equipment, average working hours for an operator or programmer and a method for prorating overhead. This rate has been accepted by several federal and state agencies operating in Wisconsin, including the Bureau of Public Roads; the Department of Health, Education and Welfare and Wisconsin's audit staff.

Fourthly, we established an interdepartmental advisory committee, composed of the major users—at that time seven departments. One of the first recommendations coming from the advisory committee was to develop an overall educational program. We had groups of approximately 30 people meeting periodically for a two-day in-depth seminar on some of the same topics which are being covered by this conference. As a part of this educational program we have set up a systems analyst training program—an 18-month program, a programmers training program and an operations program. At the same time we began an indoctrination program for all supervisors. Frequently, data processing managers are technically competent; they know how to make the machine work, but they have neither the sensitivity nor interest to recognize and react to user needs. Their attitudes can destroy relationships with user departments that someone else has spent a great deal of time cultivating.

And finally, we wrote a long-range plan, a five-year plan which incorporates the needs and ideas of the user agencies, projected equipment innovations and our own ideas of feasible applications which could be adopted in the future. But long-range plans are never static; we are already revising ours.

I would like to caution you at this point: administrative support, task-force recommendations, time-phase analyses, educational programs and long-range plans are all necessary tools to develop a state data processing function. However, these tools do not automatically establish a data processing center—you still have to implement plans, time-phase analyses and so forth.

Implementation also has its problems, or at least it caused some in Wisconsin. The first concerns the educational phase; we had firmly decided to train our own people if possible. Well, most of them responded to training, but certainly not all of them. Some employees were unable to make the transition from a punch card to a piece of magnetic tape—they cannot get used to the variable length record. This resistance to change does not end with the technicians; agency heads can be as reluctant to change as a first-line programmer. And this problem is difficult to handle because, in my opinion, it has no relation to the length of service, age, employee training or any other single factor. People in their twenties may have already developed what we call an 80-column mind, while some over 60 have no problem in changing from tab operations to stored program applications.

A closely related problem is departmental loyalty. Again, since we used in-house personnel, some of our employees came from other departments, and they had a tendency to be loyal to that department rather than to ours. For example, one particular operator frequently received a call from his previous employer requesting a "hurry-up job." The next day we would find that payroll was eight hours behind schedule because the operator had reshuffled the priority schedule to take care of the job from his previous employer.

Anytime you centralize existing data processing facilities you will have problems of physical planning and equipment mix. You will have twelve sorters when you only need one, for example. And even if you have a proper mix of equipment to begin with, individual modifications will be necessary. You may have, as we did, seven punch card operations to create check-writing cards for seven individual departments. It was necessary to write one composite program and make the necessary modifications for each department. Furthermore, we had non-uniform codes; out of 17 types of records in the state we had 12 different identification numbers. There were nine ways to classify the city of Madison: by a sequence of county numbers, a sequence of city numbers, alphabetically, alphabetically by time sequence, federal employer's number, geographic locator, and so on. All of these had to be translated into one single code for processing—and that is a real job.

When you start projecting the amount of space necessary to house the operation, you will have a tendency to underestimate your needs. When I first joined the department a new state office building had just been completed; the space analysts had been able to eliminate three floors from the original design through efficient space utilization. Since then we have leased three new office buildings, averaging around 80 or 90 thousand square feet and we have another on the drawing board. Yet we still compliment the designers who were able to eliminate three floors on the first building!

There are many other problems: poor systems design and documentation are two classics. Someone once told me that he had received a departmental design on the back of an envelope. I have a better story to relate—we received a design that had been written on the back of a paper towel, after the designer had wiped his hands. It is impossible to process data meaningfully until you have some idea of user agency needs—a systems design—but these designs are very difficult to obtain.

Furthermore, if you inherit job processing from another department, you simply must have a complete history of that job and its contents; the job must be documented. We inherited one from the Department of Agriculture entitled HOMER, but no one bothered to tell us what HOMER meant. It seemed perfectly reasonable to the two agricultural analysts that the "herd owners master record" should be entitled HOMER, but we spent a lot of needless time and effort trying to document the program.

Some of these problems can be solved by specific rules and procedures; others, as you probably know, are only solved by time. It takes time to reeducate personnel, to replace some individuals, to acquire appropriate equipment and to establish a sound working relationship with user departments. Above all, it takes time to teach people within the data processing department that their single aim is and should be service. If there is anything a data processing department is not, it is not an end in itself; it's not worth the powder to blow it up nor the energy to throw it off the dock if it is not providing a service to the user agencies.

We are ingrained with this idea of service in Wisconsin and, with the basic clerical applications underway, we can now begin to examine some of the more fruitful—from a long-range viewpoint—applications of data processing. We will begin working on the feasibility of a common identifier—a common way to classify individuals and data; we will also begin working on case records. Although one has to be careful about the privacy issue, I am personally convinced that, for example, if a case worker can obtain a great deal of information about an individual or a family prior to a visit, he will be better equipped to help that family or individual. What is the family's history of unemployment? Is there a criminal record? What is the family environment like? What is the current income status and so forth? As it is now, each case worker, regardless of department affiliation, spends two or three calls getting this same information and perhaps it is not accurate. Result: fewer people receive help than need it. There are many similar problems that should be undertaken but this one example will give you some idea of what we plan to do in Wisconsin.

In conclusion, I am firmly convinced that the states must take an active role in examining the type of problems I just mentioned—common identifiers and case records. If not, we may well be abdicating another role to the federal government.

The Changing Winds of Montana

K. ROSS TOOLE

Currently a Hammond Professor of Western History at the University of Montana, Dr. Toole was the Director of the Historical Society of Montana, the Museum of History in New York, and the Museum of New Mexico. As an expert in the field of Western History, he has authored several books on Montana and the West and has held editorial positions with *American Heritage, The Montana Magazine of History,* and the *Universty of Montana Press.*

K. ROSS TOOLE

The Changing Winds of Montana

That the winds are changing in Montana may be debatable. Personally, I think they are—but I am an historian and I would be the first to admit that my definition of change may not be yours. The matter is relative; something like the old saw about the man who asks an acquaintance, "How is your wife?"—only to receive the answer, "Compared to what?"

But even if the matter of change is comparative, let me speculate about it for a moment, in the kind of isolation that historians are sometimes too prone to create, and with apologies to the economists who read this—and with further apologies to any historians who may be about—because historians aren't supposed to speculate, especially about the future.

Any discussion of changing winds in Montana, for me at least, has to be based on the contention that we are on the "hither edge" of change, not yet caught up in the middle of it, not yet deeply involved; not yet, indeed, committed. And that, really is the core of this essay.

I am not really interested in the projections of the United States Census which show relatively little growth in population in this state in the foreseeable future. I don't think it would take much penetrating economic analysis and projection to illustrate that in relative terms there is nothing on Montana's horizon which will very quickly produce: (1) a broader tax base, (2) a much wider diversification of our economy, or (3) "boom" conditions in any real sense of the word.

Yet I do believe that we are on this "hither edge," and that statistical projections notwithstanding, we are confronted, right now, with basic kinds of decisions of great moment to our future. I believe that if we do not make these decisions wisely on the basis of the long-run rather than the short-run, we can mortgage the future, dissipate waste, and profligately spend what we ought to save and harbor.

Montana was conditioned by (was the victim of, if you wish to put it that way) several combining factors that held it tight in the embrace of circumstance:

(1) It was remote—far to the north of the east-west axis of trade and commerce that tied western growth to eastern. The coming of the railroads did not alter this geographic fact. Distance represented cost in 1860; it represented cost in 1900; it represents cost today.

(2) Montana was rich in raw materials: metals, timber, grass (which made beef), wool, oil. But its distance from the channels of trade meant that it could not fabricate, which meant that as early as 1870 its economy was already clearly colonial, with marked absentee ownership and a widening gap between wealth produced and wealth kept in the state.

(3) Montana's raw-materials "boom" occurred just when the trust was emerging as the dominant device on the American economic scene for the exploitation of resources and the feeding of the hungry industrial factories of America. Montana got caught in the system—and remained there long after the trust, in its early and classical forms, had passed essentially from the American scene.

So, as of 1900, three-quarters of all the wage earners of Montana were dependent on the Anaconda Company which continued to keep enormous economic and political control over state and local affairs for more than half a century.

(4) The argument from 1903 to the 1950's was not whether Anaconda ran the state (with their ownership of most of the daily press and their tight control of the legislature), but whether they ran it well or poorly. Quite obviously, they often ran it well, if conservatively. The point to note is that Montanans literally did not develop certain root skills in the arts of planning and

self-government because in many essential respects they were not self-governing; they did not make many basic decisions.

(5) The legislature, grossly malapportioned by the time of the 1940's, operated on a locked-in system dating to 1900. It had resisted the progressive movement that swept America in the first fifteen years of the new century, a movement largely related to reforms in state and local government; it had resisted reapportionment, tax reform; it had resisted interim studies, planning of any sort; it had resisted constitutional reform, judicial reform; it had held grimly to its budgetary control over the cities; in short, it had changed not at all between 1900 and 1950.

Now none of these five factors was conducive to change; none of them led to a salubrious climate for increased population or diversification of the economy in the state. If it were all to be boiled down into one oversimplification, one might say that most of our ills were due to *the high cost of space*—geographical, not outer space; and only Anaconda could really surmount that cost—and then only because of the fabulousness of the raw wealth.

Over and over again, from the early days of settlement to recent years, Montana's businessmen, ranchers and farmers have cursed distance and space.

How very odd that what has so long been our curse, now bids fair to be our greatest blessing! How very ironic and bitter it would be if we fail to understand that simple fact and turn the blessing back into a curse.

I am less interested in the changing winds of Montana than I am in the winds of America that are blowing across the face of Montana. For America has run out of space; it is fast running out of pure water, pure air; it is running out of distances, wilderness, trees; it is running out of places where the sky comes down the same distance all around; it is running out of lakes and fish and game; it is running out of beauty. America has fouled its own nest—nearly all of it.

Oh, come now, you say—it isn't that bad. No, not yet. But if there is merit in examining fifty years into Montana's past to make a few germane comments about the present; it may be wise to try to peer fifty years into its future. And somewhere along in there, what we do today is going to blueprint indelibly what we are then.

We are, surprisingly, in rather good shape to make some basic decisions now—or soon. Maybe such a realization indeed can help change the shape of things to come. Since 1950, these things have occurred:

The Anaconda Company no longer exerts a control in the state much beyond the legitimate influence it should have, as a business with heavy investments in the state. It has sold its newspapers; its control of the legislature has diminished swiftly. The legislature has been reapportioned. While the first reapportioned session two years ago disappointed many people who anticipated radical departures from old ways, no one who followed the sessions of the old and then the reapportioned performance has reason to be other than hopeful.

Interim studies are now permissible; state planning has been accepted as a function of government.

Moreover, Montanans are now agitatedly debating and reading about basic problems: air and water pollution; preservation versus conservation versus multiple use. The press is still often criticized for apathetic journalism. But no one who remembers anything about the newspapers Montana had formerly can be other than relieved and hopeful that we have emerged from the dark night of the press's captivity—because the press is terribly important to change.

These are important changes—because they mark basic departures from the old rigidity, the locked-in system that gripped the state prior to 1950. There is nothing revolutionary about them—and, of course, people not interested in history and many under 35 years of age aren't even aware that these changes have come about. But they have occurred—and they matter. They matter because in concert they free us to study what we are, what we have, and what we want to become. They free us to plan.

But how easy that is to say—and how hard it is to do! To do well! And how perilous it is to do it poorly!

It takes temerity to say this to an audience peppered with planners, but let me suggest this to the nonplanners, since I am sure the planners already know it: One of the last places in America where final commitments have not been made with respect to natural resources, the ecosystem, the water, trees, and wilderness areas, the land—is the Northern Rocky Mountain region and the Northern Great Plains.

Montana sits astride this area, dead center and involved, but not up to the hilt. Right now, controversy embroils some of us concerning water pollution, air pollution, game management practices, preservation versus conservation versus multiple use, water management, timber management, etc., etc., etc. It should involve all of us.

These controversies take place in the context of rapidly altering national attitudes toward space, water, wilderness, game, recreation and also in the context of the rather old conflict between private enterprise and public welfare.

The legislature will be increasingly bombarded with bills concerning Montana's resources—most of them carrying the banners of emotional partisans, many involving conflicting interests, many using discrepant statistics, rumor, and misinformation.

How then shall the planner plan? Can he avoid embroilment as a partisan? What basic philosophy can he employ so that he does not mortgage the future for profit in the present? Recognizing that the state needs to grow and prosper and that the private sector is the key to growth and prosperity, what regulations should the planner recommend so that today's private sector does not rob tomorrow's? What of fifty years from now?

There are a hundred such rhetorical questions which would merely reinforce the contention that the planner had better plan broadly and for the long-run, not narrowly and for the short-run.

In 1955 and 1956 the State Planning Board energetically sought to bring pulp mills into Montana on the basis of the fact that the industry would tie in beautifully with existent lumber mills and stabilize the lumber industry. It believed on the basis of information copiously provided by the pulp industry itself, that modern pulp plants caused no appreciable amount of stream or air pollution. It seemed an admirable plan in 1955 and 1956. Pulp mills needed vast quantities of waste wood material which western Montana could supply in abundance. Pulp mills needed vast quantities of pure water which western Montana could supply in abundance. Western Montana needed new industry, more people, which pulp mills could supply. It was clear at the first hearing that plans called for more mills in due course and that "if a pulp mill locates near Missoula it will be the first of several."

So the bargain was struck. Recently a suit was filed in federal court in the 9th Judicial District, on behalf of certain citizens of Missoula, by the Environmental Defense Fund of New York asking for an injunction against Hoerner Waldorf Corporation for severe degredation of the ecosystem of the Missoula area, alleging that sulphurous compounds emitted by the Missoula plant are poisonous to plants and to man. From 1957, when the plant was completed to this day, the presence of the pulp mill has caused furious opposition in the Missoula area; it has aroused unparalleled public agitation; it has led to furious legislative battles and to reams of proposed legislation and countless hours of hearings and pounds of emotional testimony.

Was the plan of the Planning Board in 1956 a good plan? Well, the mill did stabilize Missoula's lumber industry; it did contribute materially to the economy of Missoula. But was it a good plan? Perhaps the acid test might be to speculate on what would happen if another mill did now propose to locate near Missoula. I honestly think the people would take up arms to prevent it. And nothing is more abiding whether correct or incorrect, in the nature of opposition to the pulp mill, than the deep-seated conviction that pollution of air and water constitutes the destruction of the most precious commodity we in Montana have: air, water, gorgeous countryside and a big sky.

What is the answer then, for the planners? I must now answer my own rhetorical questions and assert that I think there is a way to steer through the confusion and emotion, to plan well and rationally.

(1) We need information, facts, about our resources. We need nonpartisan, unemotional facts, numbers, values and statistics. Above all, in this regard, we need to use the computer, without which the task is impossible—because the facts must be counted, interrelated, immediately available—because the natural, physical and social sciences must be coordinated—because the essence of what I am talking about is information retrieval. Without these facts—and without their computerization—no one, is going to plan wisely or well. If that makes too much of a god of the computer, so be it—I, for one, will happily worship at that altar.

(2) We need to regard our natural resources as renewable assets. We must not spend the principal, only the interest. The planner is the custodian of the property of the fifth generation unborn. He must plan for the long-run, not for the short. His task is not to bring industry, as such, into Montana next year, but to think about what will attract the *right kind* of industry to Montana in an America sick and tired of the megalopolis ten years from now.

(3) We need to stop bidding in a buyer's market and coolly wait for the seller's market. We will have, if we are careful, something terribly

valuable to sell. I know you have been waiting for me to answer the question: How do you convert space, beauty, lakes, trees, into dollars? Aside from a perhaps much overrated tourist industry, how, precisely, do you convert these things into money?

I simply submit that the flight, industrial as well as personal, from decaying urban areas is going inexorably to continue and that it *will* affect us; that if we are ready we can fit it into our scheme of things—if we are not, we cannot.

I think there is abundant evidence that the industrial flight is permanent, that neither urban renewal nor any other national, state or local device will stop it. You see it with startling effect to the south of us—in Colorado: Greeley, Boulder, Fort Collins. You see it, indeed, all over the Mountain West. Not here yet. But wait. It will move north because it has to.

Not steel plants, not heavy industry and, pray to the Lord, not pulp mills. But small industries, light industries, clean enterprises.

So I simply submit that what has been our curse is rapidly becoming our blessing—if only we recognize it in time; if only we recognize that what we have, and are, will very soon be what they want.

In the meantime, we should not merely sit and wait. Planning presently underway in our universities should be accelerated. The State Planning Board should be fully supported with a realistic appropriation and the knowledgeable endorsement of the state administration. Economists, political scientists and researchers and scholars in the natural sciences should be aggressively encouraged to turn their attention increasingly to the problems of the state and to the interrelationships of the natural and social sciences in the process of charting Montana's course for the next generation. No opportunity to avail ourselves of federal funds to subsidize these studies should be lost. And before long, all those involved in these endeavors should consider the problem of coordination. The left hand simply must know what the right is doing.

Beyond that, I have only one adjuration. In the last analysis, planning on whatever level can only be translated into change and progress by a political process. There must be no vacuum, no breakdown in communication between the scholars and administrators, between the planners and the executive and legislative branches of government.

All this constitutes a task of magnitude and the time is short, but Montana has the talent if it can find the will. The long term rewards are nearly incalculable. The consequences of failing to pursue the task are grim to contemplate.

Executive, Legislative and Judicial Considerations for Information Systems

JOHN A. KENNEDY

Following his training in engineering at Northwestern University, Mr. Kennedy has been active in the field of electronics and communication. He was the Director of General Services, State of Illinois at the time of his participation in the IMPACT conference. He has since left that post to join James Electronics, Inc. His firm is a principal manufacturer of components and subsystems for the analog and digital instrumentation industry.

JOHN A. KENNEDY

Executive, Legislative and Judicial Considerations for Information Systems

The first step in a coordinated information system is to create a structure that is compatible with the existing responsibilities and prerogatives of the various branches of state government. The executive, the legislative and the judicial branches and all of their subdivisions must be considered.

The two critical subdivisions are the executive and the legislative. There is a natural apprehension at reviewing the prerogatives of these two branches of government from the inside. There is always the fear that some of the responsibilities, some of the rights, some of the opportunities of the legislative or the executive branch, may be either changed or adjusted by such a radical new concept as a consolidated information system. We must face the fact that introducing an information system begins with people suspicious that these new concepts may not be to their best advantage.

The information system structure should be concentrated in the executive branch. It should be answerable primarily to the governor. It must be part of the whole budget system. It can give the governor the modern tools he needs for decision making. The organization must have enough authority to insure that there is a compatibility between agencies and between parts of the executive branch. In each state there is a different constitutional structure. In some states, a relatively strong governor, capable by management decision of creating the necessary authority and structure can insure a practical management information system. In other states, constitutional limitations may divide agencies, or come between offices. Each state must pattern its own particular program to the structure in which it lives. It must find the necessary changes in tone, adjustment and authority that will make it part of and not separated from the normal process of government in that state.

In almost every instance it will be ultimately necessary to generate legislative action so the type of structure will be effective. Assuming that legislative action is needed, then the primary problem is to plan on interesting the legislature in what "it can do for us." An effective management information system can go a long way in reducing the frustration of the legislator who is unable to grasp the present mountains of paper work and reports that fail to give him the type of concise information on which he will ultimately have to vote a "yes" or "no."

The real objective of any information system is to give the legislator, as well as the governor and his agency heads, a final simplification with adequate but not excessive details so a decision can be made on any program. The program should be built with the concept that the supporting data and format should have a commonness between the various services and programs of the state. It can be the basis on which the legislator can obtain a more informed judgment of the governor and his program. It will improve the democratic process by bringing into common agreement the two separated and independent branches of government, and make possible the best division of resources within a state. There may be justification for every program, but it is only when the justifications of programs can be presented in a common format which is digestible and understood, that a real decision can be made.

One of the fundamental problems in creating an effective management information system is to attract broad support of interested people. Finding the people who wish to champion the cause is of major importance. Generally they can be found in the budget sections of state government; sometimes they are in the governor's office. I don't doubt that in some states it will be the governor himself who will have the feel and the understanding to make this basic program go forward. Under any conditions, before any program can go forward, it must have a leader. Under certain circumstances, this leader could be a member of the legislature—an alternative all to the good. Someone who is knowledgeable and who understands the objectives as part of the legislature can blend the problems and the conflicts toward a solution. The program must always have the support of the governor, legislative leaders, and some ongoing support of agency heads. My experience has been that at the beginning most agency heads are reluctant to give up any of their prerogatives. This reluctance usually disappears when the concept of consolidation has attracted experts to state government who can show the real value of the program to the agencies, as well as to the total operation of state government.

The legislation that is practical for your state may not follow the format of any other state, although naturally other states' legislation should be examined. Organizations that are operating in other states should be contacted. The mistakes of the past can be avoided in the programs of the future. Be new—be different—develop your own unique mistakes!

In the State of Illinois we learned a great deal from the states that had already moved toward consolidation of information services. We were able to get an effective legislative bill which had authority—and a fiscal revolving fund. All monies involving charges and costs of information services pass through the Management Information Division. This includes computers, hardware, programmers, etc. The Illinois legislation made it possible for the Department of Finance to build a professional team. They have after four years of hard work and struggle completed a true data center—not one that centralizes, but one that brings together various computers, related hardware and the various needs of agencies. Agencies now support and assist one another rather than attempting to live alone. We have two floors of new generation computing equipment with interconnection. We have experts who could not be afforded by any one agency. We have what are the beginnings of a true, flexible, complete data center.

There has been only a minor amount of friction in the area of legislative support. To assure continued legislative support and interest we had an excellent commission which monitored and examined the beginnings of the Management Information Division with its problems. It began a study of the possibility of working with local governments. Unfortunately, through a misunderstanding this commission was not renewed in the last legislative session—which has irritated a number of representatives who had felt a growing interest in the information area. I am sure this will be corrected at the next legislative session by the re-creation of a legislative commission to work with the Management Information Division and the total state problems of information flow. It is an excellent vehicle for progress and conciliation.

Flexibility in exercising authority is very important in attempting to impose centralized control over agencies that have traditionally operated independently. For many of the same reasons that one state's organization and plans are seldom unreservedly adaptable to another, Illinois did not attempt to enforce rigid procedures upon all agencies at the same time and in the same way. When applying any new procedure, the problems unique to each agency must be considered—timeliness must also be kept in mind. One thing must be foremost in the minds of those responsible for centralizing control—each agency must be examined individually concerning possible disruption of processing schedules, location, degree of technical competence and the size of the agency and its workload; otherwise, deficient planning may negate any savings accrued through consolidation. Our legislation permitted us to phase into centralized control without impeding agency operations by providing us with an array of control switches, triggered discreetly, to guide each agency down the right track.

After visiting several state governments, corresponding with many others, and consulting with the Director of Finance and state agencies in Illinois, we formed our conclusions as to the direction the Management Information Division should take in carrying out this new responsibility.

To cover the broad duties included in the Illinois legislation, the Management Information Division was organized into three sections: Data Processing Development, Fiscal Information and Administration and Education. The first section, Data Processing Development, has the responsibility for coordinating all data processing in the executive agencies. This section is headed by a very competent data processing professional. The second section, called Fiscal Information, has the responsibility of providing the governor and the Director of Finance with information necessary for the formulation of fiscal policy and is in the process of developing a statewide fiscal information system. The third section, Administration and Education, has as its primary objective the improvement of the productivity of state personnel engaged in processing information.

Centralized controls are essential to economic operation of state data processing equipment. However, the more tangible benefits to state government are through centralized services that increase the efficiency and productivity of state agencies. Services rendered to agencies from a central source should be primarily those that are beyond the capability of a single agency. Educational programs, software development, standards for programming, operations and systems, a central support group for systems analysis and programming and a computer laboratory for program testing and conversion are some of the central services that result in tremendous improvement to state government operations.

For example, we determined early in our studies of agency operations that misuse of expensive computers was mainly the consequence of inexperienced personnel and inadequate staffing. While responsibility for education is not explicit in our legislation, it was obvious that development of skills is urgently necessary for successful operation of this equipment. Consequently, the Management Information Division established an Education Center.

The persistent and widespread problems created by a national shortage of personnel competent to fully utilize computers, and the consequent spiraling of salaries in this area, are being successfully attacked by expanding the supply of trained technicians. Clearly, control of the selection and procurement of EDP equipment, no matter how successful, will fall short of realizing the broader goal of economical use of computer systems unless competent personnel become available in adequate numbers. The cooperation of the state's data processing managers was enlisted by the Division, which then initiated and carried through to successful operation of an educational program. With their support and advice, we recommended substantial revisions and additions to the official job specifications in this area. These recommendations, based upon realistic education, experience and performance requirements were adopted by the Department of Personnel. Related salary reclassification, consistent with levels maintained by competitive employers, was also adopted by the Department.

As an innovation in the state's in-service training programs, the Division, with the approval of the Department of Personnel, established a series of trainee positions in the EDP area. State agencies may make contracts with the Management Information Division for enrollment of their employees in formal courses conducted by professional instructors in the Division's Education Center. Eligibility for enrollment is established through written and oral examinations conducted by the Division. Students remain on the payrolls of their respective agencies while enrolled.

Graduates of a course become eligible for promotion. The courses are sequential, and, in conjunction with the revised job specifications and salary structure, they offer paths to career employment that are attracting an increasing number of desirable applicants to state employment. This educational program has reversed the previous trend which had been draining the state of the more skilled employees. Now, with the professional standards established by the Management Information Division and the challenging and rewarding careers that are available, we are attracting potentially valuable persons into state government.

Considering that for many years the state government of Illinois, along with other states, has encountered difficulties in recruiting and retaining qualified personnel, especially in professional and technical areas, this successful innovation sets an inspiring precedent for other state agencies.

The Management Information Division, through its training center, has provided educational instruction to over 300 state employees in the past eighteen months. A formal data processing "Programmer Trainee" curriculum has been developed which has so far graduated over seventy new programmers who entered state service.

We felt that more important economies could be achieved through the establishment of a computer laboratory for use by state agencies. The important benefits of this laboratory to the larger user agencies are from services such as simulations, program testing, conversion processing, personnel training and additional computer capacity for peak workloads. For the smaller agencies, the computer laboratory provides the full range of data processing services through systems analysis, programming, testing and production scheduling.

With regard to the politics of a management information division, it is my personal opinion that it should be manned with professional people. It should answer to the governor or to a director of the budget or finance who, in turn, is generally an appointee with the right of political decision making. Rarely does such a division need true partisan political decisions. Certainly, the party in power that created the new program, and insured it would be successful, has the nominal right for credit on the political marketplace. However, there is little room in such a complicated and technical subject for the type of political patronage that has been practiced in the past in some areas of state government. Such thinking has become somewhat obsolete in any part or framework of state government.

The selection of the key people for the information agency should be done on a purely professional basis. Naturally, as a politician and as a Democrat, I always hope that the right people will arrive and suddenly announce they are *Democrats.* They should, however, first be evaluated for their qualifications. This is the most important consideration in selecting personnel. They should not be totally, technically oriented; this applies particularly to the manager of the information division. This man must work with people—a whole series of people who have responsibilities, who have rights and prerogatives which they are unwilling to give up unless there is a real justification. This is frequently true of agency heads; it is particularly true of legislators who are frightened at the thought of information becoming even more obscure and difficult through the language of computers, rather than in the form of the written report. So the manager must have the instincts to recognize where some compromise, some change or some difference in format or approach must be made. This is the real answer to moving the total program forward. With the correct and proper selection of people, with an adequate budget, which usually can come from the expenditures which have previously been given to the individual agency, more can be done at less cost. There are considerable funds in the federal programs that a state can direct toward a total management information system. The state information system must begin bringing together the vertical services of state government so that agencies and administrators can talk together, and can be evaluated together.

The needs of the legislature must be given adequate priority by the new information group. Adequate education should be given to each legislator on the improvements in form and flow of information. If real savings are affected, let them know about it—but don't sell the program on savings alone. The real savings come from better decision making by the governor *and* the legislature.

There are improvements that can be introduced in the legislation process itself. Illinois now uses data processing techniques in supplying current information on status of bills. Each legislator receives a daily journal printout with information on each bill. Some states have put their statutes on computer and standard programs have been developed. These direct improvements assist in "educating" the legislator in the real values of current, correct and complete information with EDP techniques.

The budget process is another valuable program for assisting both the executive and legislative branches during a session. The so-called balance sheet of state government often lags behind the approvals and disapprovals of revenue and appropriation bills. Name me the state that doesn't fight this process right down to the final bell. Many a tragic mistake has been made through inadequate paper and pencil estimates —many times involving millions of dollars! EDP systems can keep a program, however controversial, current.

The third part of our democratic triangle must not be ignored in planning a state information system. We are all familiar with automobile licensing and accident violation information techniques. They have become common in practically every state. This simple use has now been extended to many other areas. Current insurance company liquidity measured against open court cases aid both the judiciary and the state's insurance director. Criminal records are now being automated. The common complaint about individual privacy has been solved by systems, technology and proper authority. In reality such systems give the citizen greater privacy when properly applied—compared to row upon row of open paper files.

The proper and correct use of information is a continuing operation, and the advice, ideas and interest by the legal profession is vital to normal uncontroversial growth.

As a last and parting thought, the key to the creation of a successful information system is really the way it is presented to the people who must make the decisions. Each governor is different. Each agency is different. Each administrator is a human being with his own talents, his own tastes and his own senses. Some have a great preference for written communication. Some prefer verbal communication—singly, or in committee. Some require a combination of these two.

A computer can accumulate vast amounts of information. The key to making this information effective to the decision maker is how it is presented to him. This must certainly be a customized pattern—a pattern that must be sensed by the budget director, really, by the governor himself. For it is a frustrating waste to see vast sums of money put into a complicated information system that appeals to and is of service only to the technocrat who is running the system, rather than to the administrator who is looking toward the needs of state government and the future division of resources.

I think an information system is a great challenge that combines the talents of people, the talents of technology and the weaving in of the great traditions of state government. As a combination they will not restrict the freedom of the citizen; they will not restrict the freedom of the administrator, but rather they will give him new tools to create broader horizons, to free him from the burdens of yesterday's statistics. It can move him into the area where the individual citizen can be considered for his own personal needs. The administrator of a part of state government can feel a real connection to the total objectives of the environment, the economics and the future of the individual state. I think management information is the structure, the foundation, of the way our free democratic society can succeed in this complicated and ever-changing world.

PPBS—A New Dimension in Financial Planning and Management for State and Local Governments

KENNETH S. CALDWELL

Mr. Caldwell is a principal in the firm of Ernst and Ernst, and directs the activities of the firm in the field of economics and community development. In addition to his extensive experience in directing management engineering studies for public jurisdictions, he has directed important studies for business and industry in diverse areas of management, cost control, plant layout and EDP. Mr. Caldwell also serves as the National Chairman of Ernst and Ernst's National Technical Committee on services to state and local governments.

KENNETH S. CALDWELL

PPBS—A New Dimension in Financial Planning and Management for State and Local Governments

Planning - Programming - Budgeting Systems, or PPBS, is hailed in many circles as the new and magic watchword in governmental finance. But, unfortunately, comparatively few people really understand its connotations and implications. Therefore, I am going to try to highlight and place in proper perspective some of the more important considerations involved.

How do you allocate and manage resources to best accomplish governmental goals and objectives? This is the fundamental question to which PPBS directs itself. In government, we are faced with a tremendous multiplication of federal, state and local programs, plus a dual demand for more and better services and increased revenues. How can we strike a balance between needs on the one hand, and resources on the other? The concepts involved in PPBS provide some good guidelines.

PPBS comprises the financial planning and management concepts developed within the Department of Defense by former Secretary McNamara—concepts which are applicable to Montana as well as other state and local governments.

What is PPBS? Let me give you a brief definition developed by a U.S. Senate subcommittee two years ago:

> PPBS focuses on the output of programs (output being services rendered) whereas traditional budgetary approaches emphasize revenue and expenditure inputs. PPBS assesses as fully as possible the total costs and benefits, both current and future, of various alternative ways of providing public services. It also endeavors to determine the rate of return from the money invested in each program as well as the rate of return an agency might forego when it selected an alternative way of providing services.

In PPBS, you concentrate on outputs, not on inputs—a 180 degree change of emphasis compared with the conventional governmental budgetary processes. PPBS is a refinement of existing procedures, not a new approach. Through PPBS, a better planning and budgeting framework for state and local agencies can be evolved which, in turn, makes it possible to do a better job of matching public services with available revenue, and for increasing program effectiveness.

The three elements in PPBS—Planning, Programming and Budgeting—are all linked together in a systematic approach. Planning involves the establishment and definition of governmental objectives. After objectives are defined, the ways to meet these objectives can be determined according to the specific governmental programs required. In the budgeting phase, all program costs involved—preferably for the life of the program—are pulled together.

Integrating the planning, programming and budgeting process provides a framework for developing needed information systems and for more effectively linking existing information systems within an agency, as well as on an overall governmental basis—integrating also provides an initial vehicle for evaluating program performance.

Let us briefly look at the traditional governmental budgetary structure. It is typically a legislative "line item, object of expenditure" budget with primary emphasis placed on changes in year to year revenues and expenditures. In all too many instances, the line item budget only provides a basis for maintaining orderly records of expenditures. Such a budget provides very little usable information—at least the kind of information needed for efficient administration or program management. But, with the ever-increasing demand for public services, is it realistic to attempt to maintain the budgetary status quo? Certainly not! More money must be added to a budget every year, and revenues must be found to support the additional expenditures. Whether it likes it or not, the governing body has to come up with the money in the final analysis or cut back programs. This is the name of the game.

The budgetary process at the state or local level is extremely complex. One cannot just introduce new budgetary concepts without also considering the practical elements involved in improving budgetary planning and control. Politics are involved, among many other things. The views on needs and funds may differ substantially between the legislative and executive branches of government. Some administrators in government are far more skillful in developing, justifying and presenting their budgetary needs to the governing body than others. As a result inequitable situations occur. The intense competition for available funds within and among the various agencies of government is in itself a major consideration.

Even discounting these very real considerations, the conventional line item, object budget does not give an administrator the information necessary to make day-to-day decisions or to effectively plan and manage his business. Should the prime focus of the budgetary process be to maintain historical records of what was spent? I submit that it should not. We have to recognize accountability. We have to safeguard the public interest. But these considerations should be an integral part of the budgetary system, not its prime focus.

The budget is and must be the key management and planning tool of any government. If it is not, then other procedures will evolve to take its place. I am not saying that we are going to see the end of the traditional budget. What we are going to see is the evolution of needed procedures and controls to back up and support the traditional budget—procedures which are inherent in PPBS. I might add that I do not think these concepts will be too difficult to sell to governing bodies. Most legislators are really interested in outputs, not inputs. Construction of a new road section or of a new improvement in airport facilities are the sort of considerations which legislators must deal with. With its focus on outputs, PPBS has something going for it from the start.

We must have, as a key element in governmental budgeting, a system which will compile and provide program (output-oriented) information on a continuing basis. Unless we are prepared to do this, we are wasting our time talking about PPBS. Information is needed by programs, not by line item and objects. A sound management system must provide the information needed to help plan and manage an organization and program efficiently and economically. PPBS requires the development of such an overall, integrated management system.

In a sense, a PPBS system can be considered as comprising four major elements: (1) program budgeting; (2) an effective and coordinated management information system; (3) system analysis—a useful tool for analyzing alternative ways of providing services; and (4) the management process itself.

Let us take program budgeting first. As the cornerstone of PPBS, the program budget focuses on outputs and involves the development of needed cost and performance information. In most governments, it is relatively easy to classify government activities on a program basis and develop the program coding structure needed to supplement the traditional organizational unit and object-coding structures. But in developing a good program coding structure, governmental objectives must be defined in terms of overall governmental functions. In a typical state, for example, all functions could be classified within one of the following objective categories: human resources development, environmental services, land and water resource development, transportation development and general government.

The next step is to develop a classification structure for the programs required within each objective category. In the field of human resources, for example, programs fall into several natural groupings. These include elementary and secondary education, general health, welfare and so forth. In the program area of general health services, for instance, programs directed at eliminating tuberculosis, venereal disease or cancer must be blueprinted, plans for improving health education and so forth must be planned and carried out.

The next level in the program structure deals with the specific services or tasks required to carry out a specific program. Many jurisdictions are introducing program budgeting within the framework of their present accounting systems. Wisconsin, for example, changed to a program format from a line item, object type budget.

From another perspective, program budgeting is the equivalent of introducing industrial cost accounting in the governmental structure. In industry cost information is available (by product) to plan and manage a business efficiently. The same thing is possible in government except that government provides a service rather than producing a product.

The second element in a PPB System is good and timely management information. A good budgeting and cost accounting system is useless without a proper system to generate accurate and timely information. An effective PPBS information system should include procedures for collecting data about both needs and resources. Data are needed to coordinate needs and resource requirements, and to provide information for planning and programming. Cost and other pertinent information will enable agencies to make comparisons and evaluations of alternative programs. Furthermore, only detailed cost and performance information will enable you to determine how well programs are being carried out.

The third element in PPBS is the proper use of management sciences (systems analysis). In PPBS, emphasis is placed on searching out alternative ways of providing public services and evaluating these alternatives in terms of their comparative costs and benefits.

Furthermore, with PPBS, you do not budget for one year, but for the life of the program—or on a five-year basis. You need good cost information to apply systems analysis or to develop decision guidelines. The management sciences can also be used to develop mathematical models for use in better planning and decision making. However, it is not enough to turn your problems over to a mathematician to attempt to reduce those problems to interesting models and formulas. Systems analysis must be used judicially. It is no substitute for good judgment.

Under our political system of checks and balances the planner, the administrator and the politician are often at odds. The planner tries to plan intelligently by forecasting future events. The politician, more realistically, understands the problems inherent in the planners' forecasts. Planning and the budgetary process, therefore, must involve a combination of judgment, experience and intuition. The message I want to get across is that this process can be improved materially through the judicial use of system analysis.

The final critical ingredient in PPBS is management itself. Program budgeting, good management information systems and the proper use of systems analysis can provide meaningful information upon which to make better plans and decisions. Management, however, must be properly trained to use these management tools. Too often, all the emphasis has gone into designing the system with little, if any, consideration given to the people who must use the system. We must recognize that PPB Systems, procedures and controls are not a substitute for management. Proper orientation and training of management must also be an integral part of PPBS.

What is actually involved in developing and implementing a PPB System? First, the basic goals and objectives of each agency must be identified and established. What is an agency's purpose in life? Why was the agency created? What specific goals is it attempting to achieve? These are the questions which must be answered.

A city manager, for example, may be responsible for police and fire services. As a goal, to say that he is going to provide the city with "adequate police and fire protection" is meaningless. His goals must be defined on a quantitative basis, perhaps in terms of the Fire Department's ability to place a piece of equipment at the doorstep of any residence in a defined area within "x" minutes. If he has based his program on this type of premise and budgeted accordingly, he has a realistic goal—a goal which, in effect, establishes the level of service to be provided.

The administrator must next determine what resources are required to carry out the program designed to achieve the goal or objective. In PPBS, emphasis is placed on programming on a governmental-wide basis. This, in itself, is a major problem. Many programs, such as health, welfare, education or public works, may involve a large number of separate agencies within a government—each planning and carrying out a portion of the entire program.

Coordinating such programs can be an extremely complex and difficult undertaking especially when it involves getting the heads of various agencies (whose objectives may differ) to agree and work out a common approach to a governmental-wide problem—much less to formulate meaningful agency-wide goals and objectives.

The next step is to determine the costs—in terms of people, facilities, supplies and other requirements—required to carry out specific programs, not just for one year but for five years.

Here the question of program priorities raises its ugly head. If for no reason but that of revenue limitations, realistic assessments must be made of the relative importance of programs. Although this can be very difficult, good program information on costs makes it easier to establish meaningful priorities.

Revenue and revenue potentials must be analyzed as well. The priority process which takes this into account should look objectively both at revenues available and program needs. Here, the administrator has to eliminate, modify or reorient programs so as to conform to available revenues, or to ask for more money. In this respect, system analysis comes into play as a useful tool for analysis of alternative ways of providing services in relation to their costs and benefits.

Performance criteria must also be developed. Measuring expenditures against a budget is not enough. Obtaining realistic measures of accomplishment in relation to plans is also a major objective of PPBS.

PPBS also helps bring into focus the question of organizational responsibility for carrying out programs. Divided or unclear administrative responsibility in key program areas will make it impossible for an administrator to be held accountable for program performance. It may be necessary, therefore, to eliminate this kind of problem through reorganization. Although the focal point of PPBS is not reorganization, per se, many times it is impossible to develop an effective program without some reorganization.

Finally, management has to be trained in the proper administration and management of the program. In all, PPBS is not a simple process, but something can be done if the desire is there.

Take a school district for instance. The first step in PPBS is to define educational goals and objectives—a job for a professional educator. A goal such as "to give every child in the district a good education" is not an adequately described goal. A tangible goal, on the other hand, would be to increase a child's efficiency in a certain language—say from one level to another over a period of time on a basis subject to measurement. To carry out the program, decisions have to be made in terms of program needs—facilities, classrooms, personnel and so forth. These costs would be summarized on a per-student basis. With this cost information, an evaluation could be made of alternative ways of providing the program. This is an area in which cost-benefit analysis can help maximize program effectiveness while minimizing costs.

I might add that the use of cost-benefit analysis can be done without necessarily resorting to complicated mathematical techniques. In one disastrous example, a large school district decided to add a new technical curriculum in computer programming. To train programmers a computer is needed, so they bought one. A few dozen students were trained the first year, while the computer sat idle 99 percent of the time. The program cost was literally thousands of dollars per pupil. This example may be hard to believe, but it actually happened. A simple alternative would have been to buy time from a local computer service bureau at a fraction of the cost of ownership.

Let me briefly summarize the evolution of PPBS, particularly in the federal government. The Department of Defense (DOD) has used PPBS since fiscal 1963. In 1965 President Johnson directed that the basic DOD concepts be extended to other agencies of the federal government. While the basic PPBS concepts as evolved in the DOD were sound, many problems arose leading to a searching reexamination of PPBS. A comparatively simple lesson was learned. The DOD operates in a much different environment than many other federal agencies. Its activities are sophisticated with sophisticated people managing them. Even before World War II, the military establishment had developed program budgets, and after World War II, pioneered in the use of systems analysis techniques.

The Department of Defense has developed comparatively good cost accounting information and, therefore, can make decisions based upon costs and cost-benefits. Secondly, the decision environment is different from that in other agencies. Once appropriations have been made, the Secretary of Defense has a considerable amount of latitude in reallocating funds between programs. In addition, there are a number of well-qualified people in management who are trained to use this type of management and cost information. Lastly, the approach followed can be called a "top to bottom" approach. They already had the bottom—program costs and information—so the emphasis on PPBS was placed at the top, emphasizing systems analysis and other techniques for improving decision making.

This is certainly not the case with most state or local governments, which operate in a radically different decision framework. Politics are a major consideration. The closer to the local level, the more important politics become. Furthermore, the top governing body grants little latitude to the executive branch to deviate from the line-item budget. Actually at the city or county level, the local administrator may control only a very small portion of the budget. This does not mean that PPBS cannot be applied to city or county government. It means that the approach and ground rules may be different. The learned, but often impractical ideas of many educators or the systems of the DOD cannot be lifted out and applied "carte blanche" to the typical state or local government. It is necessary to develop a PPB System that is responsive to the particular needs of particular agencies, as well as one that also recognizes the practical consideration involved.

This can be a difficult process, but one we all have to face up to. While the federal government is shifting to a program-oriented budgeting process, many state and local governments still cling to traditional budgetary concepts. This budgetary status quo cannot last long, considering the ever-mounting pressures for improving services and reducing costs.

The handwriting on the wall is very clear. The new look at the federal level—call it "creative federalism" or what you may—is bringing, or will be bringing about drastic changes in the budgetary approach at all levels of government. In fact, PPBS—in some form—may well be a mandatory requirement where federal monies are allocated to or expended by state or local governments. It may not be called PPBS, but the concepts and approach will be the same.

To illustrate, the Federal Highway Program of a few years back required local regions to plan cooperatively for their future interstate highway needs. Subsequently, the federal government required state highway agencies to develop and use more sophisticated planning and budgetary concepts in relation to federal reimbursements. If these agencies did not comply, federal funds could be cut off or frozen. Because of the strong role taken by Uncle Sam, state and local governments are now planning cooperatively to meet area-wide needs. While problems are still involved, this represents a constructive step forward.

The same thing is true in other program areas. The recently enacted Highway Safety Act is another example. The federal government requires that statewide safety programs be developed which will meet federal criteria in a number of specific program areas. Again, unless a state prepares an acceptable master plan and meets certain criteria, highway construction funds are in jeopardy.

The same kind of constraints are or may well be placed on any federally funded program area and may serve as a stimulus for forcing many governmental jurisdictions to take a new look at their old budgeting approach. Installation of uniform accounting systems may not be required by a federal agency. Instead expenditures and accomplishments must be reported on a program basis. In order to provide this information accounting systems will have to be changed.

We can look forward to widespread introduction of program budgeting to supplant or to reinforce the line-item, object budget. We will have to modify accounting systems to conform with program reporting requirements on a program basis, particularly where federal funding is involved.

Where does PPBS generally stand as far as state and local governments are concerned? Much has been written, very little has been accomplished! A number of projects have been undertaken at the state and local level. One of the most interesting of these is the "5-5-5" project. Under this project, PPBS programs are under development on one basis or another in 5 states, 5 counties and 5 cities. The project hopes to establish guidelines for introducing and implementing PPBS at the state and local level.

At this time, PPBS is a wide open field. The methodology is there; the concepts are there; the approach is there. A lot depends upon the willingness of state and local government to abandon traditional practices and take the first step forward.

Montana would be much better off to plan now for such changes, instead of approaching the problem on a piecemeal basis. In most instances, these concepts must be sold to the governing board, which means educating them in the application and the use of the systems output. This can be done, and if done properly—starting at the bottom with the accounting and budgetary structure—a substantial contribution to improving government in Montana will have been made.

Centralized Computer Services for Internal Management

GARY A. McLEAN

At the time of the IMPACT conference, Mr. McLean was the manager of Management Services with Touche, Ross, Bailey and Smart. He has since moved to the position of President of Data Processing Consultants, Inc. Mr. McLean has also been associated with the Boeing Company, Tally Corporation and the U.S. Army Signal Corps. He was responsible for the design of several EDP systems including the implementation plan for a statewide ADP Service Center in the state of Washington.

GARY A. McLEAN

Centralized Computer Services for Internal Management

Centralization is always a controversial subject. I hope to relate my thoughts here to centralized data processing services, but the whole specter of centralization raises its ugly head. If I can limit my discussion to some of the technical aspects pertaining to data processing services perhaps I can avoid getting involved with the emotional aspects of centralization.

The concept of centralized services for government agencies certainly is not a new idea. Governmental centralized services have been provided for many years in such areas as purchasing, personnel placement and recruiting, grounds and maintenance, security and utilities. If we look at data processing as strictly a service function, which it is, it thus fits into this pattern of centralized services.

Let us first assume an agency has systems where data processing services have economic justification. This is the basis for any organization to enter into automated data processing systems. The extremely high initial cost of computers and their associated technical support personnel make it difficult for many government agencies to enter into the ADP field. Here are some of the more significant problem areas:

1. The initial entry into ADP requires considerable funds to implement the ADP hardware and to hire and organize a qualified staff. The resulting cost savings from installing ADP systems occur some time after installation of ADP systems. Thus there is an inverse cash flow relationship with the increased efficiency. This requires the agency to spend money maintaining the old, less efficient system while preparing it for the future with more efficient systems.

   This problem is compounded in many states where the agency is limited to planning only on a biannual basis. In some states the legislature is reluctant to be very concerned about spending more money in one biennium for potential long range cost savings.
2. It is difficult for many agencies to attract the top ADP professional personnel. Often an agency cannot show sufficient responsibilities to support the necessary competitive salaries or provide sufficient technical challenge for the individual.
3. It is difficult for many agencies to realistically evaluate the capabilities of the ADP personnel to fill the key ADP management positions. Unless these positions are filled with properly qualified personnel, it is impossible to train the lower level positions from existing staff positions in other parts of the agency.
4. Many agencies require highly specialized support personnel for relatively short periods of time. The agency cannot realistically afford the highly specialized personnel for a full-time staff position.
5. Many agencies are finding it difficult to integrate the higher salary levels, special spatial and facility requirements, training requirements, and other specializations demanded by data processing personnel within the present organizational and personnel structure of their agency. This can cause severe imbalances and inequities among other agency employees.
6. Many agency management personnel feel they are not equipped to manage the ADP functions in their agency. They do not understand ADP techniques and feel they are not capable of learning about them. Consequently, many agency managers are reluctant to develop a strong internal ADP effort, when they feel they cannot control or provide the necessary leadership over this area. This concern is realistic, but of course anyone willing to expend a little effort can learn what is required about ADP to manage the function. Some of the traditional management tools may be modified to effectively control this function.

Two major areas within state and local government are ripe for centralized computer service. The first area is the central service bureau supplying data processing service to the individual agencies while the second is concerned with operation of large, generalized systems which are common to all agencies.

There is a simple economic law pertaining to computers, the cost/output-performance ratio is not linear. This means a very large expensive computer can accomplish more work than a number of small computers costing the same amount. The large machine often can do more work in a shorter time than one of its equivalent cost in smaller machines. Thus if agencies share their resources they should be better off from a service point of view than if each had its separate computer.

The service bureau concept thus employs a very large machine, usually far beyond the financial capabilities of any one agency. Of course, all the necessary peripheral and support personnel are also located in the service bureau, and thus the size of the installation promotes economies of scale and specialization of labor. This usually increases the productivity of the employee.

Besides pure computer power the service bureau usually supplies other necessary services such as:

1. Specialized hardware services such as digital plotters, graphic display units, large random files with fast access and data communications equipment. These types of units are very expensive and an agency must have a large utilization requirement before it may economically justify such choices. Again, sharing the costs among many users can make such equipment available on an equitable basis for all agencies.
2. Specialized software service and support. There are a number of routines available, both scientific and commercial, which are applicable to many agency needs. Many of these software packages can be purchased and used by many users. Some of the software packages require specialized training and knowledge to interpret the programmed results. Again economies of scale make some of the advanced, specialized software packages practical for the smaller ADP user.
3. System analysts and programming support. Many agencies need to implement a system in a short time period. Often the agency does not have sufficient technically qualified personnel to implement the system within the necessary time requirements. The service bureau would have trained system analysts and programmers to fill such short-term needs. The service bureau would also have specialists in highly technical areas, such as large random file design, data communications and online systems that would be available to agencies as consultants.

   The technical personnel could be charged to the agency on a per-hour basis. Their rate would include their direct salary costs plus overhead, such as training, supervision, etc.
4. Key punching, EAM and other data processing support services. The service bureau would be able to supply either full support, such as the primary agency key punch input, or be an overload group to handle special work for agencies. This kind of service is often necessary during peak operating months of an agency, or to handle special situations such as file conversions.

Some system needs are duplicated by the various agencies. These systems are usually a result of some centralized function controlled by statute. Examples would include: (1) Payroll (payment and expense distribution); (2) Personnel (recruiting, register control, budget position control, wage and salary studies and statistics); (3) Vouchers Payable (purchase order control, encumbrance accounting, payment and cost distribution); (4) Inventory Control (ordering and expense distribution from central stores); (5) Budget Preparation (budget preparation per state standards with easily available historical data); and (6) Accounting (general ledger, funds control program accounting, etc.).

These systems are often very stringently controlled by legislation. Consequently there is a great deal of standardization between agencies. Theoretically one master system could be organized to process this type of system for all agencies. Unfortunately, in many cases, each agency has interpreted the legislation differently and designed systems to fit local agency needs. Thus there are a large number of fairly small individual differences in the operation of a common system, such as payroll.

At one agency the distribution program provides multiple fund payments, while in another agency this requirement does not exist. The design and implementation of centralized master systems is not an easy task, but most studies indicate that such an approach will result in large cost savings. There are usually many technical and compatibility problems that have to be solved. Many states are attempting to isolate such systems and centralize their operation. The agencies simply feed the system and receive output reports. In most well designed systems the agencies have the option to receive a copy of the output in machine form (magnetic tape, cards, etc.). The agency then uses this output as an input to their detailed accounting systems. The most popular centralized system being implemented today is payroll. Many states and local governmental groups are sharing a common payroll system.

There are problems and promises in all of centralized ADP services, but there is no question in most people's minds that a large centralized ADP service is more efficient. The centralized service may avoid many of the operating problems of individual installations. We now may obtain larger, more powerful and efficient hardware, utilize better software, obtain specialized technical personnel and equipment, and be able to effectively take advantage of economies of scale.

Centralized master systems single out some obvious redundancies. There are many more areas where agencies are essentially "reinventing the wheel" with their parochial approach. For instance, have you thought how many name and address files exist in a state? In one case we found 32 separate name and address files for only 18 agencies; that is, each agency was keeping anywhere from 1 to 10 files for basically the same citizens.

It is possible that one master file could be designed and maintained at a central location. The citizen would only notify one place when he moved. The agencies would have access to the file to fit it in to their own needs.

A second type of concurrent systems development occurs when very similar governmental functions are combined into "package" programs. For example, similar programs (computer systems) can be developed for the Public Employees Retirement and the Teachers Retirement Systems because both are based on the same actuarial basis. Common functions are also shared by state and local health departments. Counties and cities are developing their own health systems, just as the state health department is, but there seems to be very little communication between the two groups. Both are reinventing the wheel. Use of a centralized ADP service center will encourage coordination and a better functional distribution of responsibility.

The third type of system is the integrated one where data that is required by several agencies is brought together in one file. As an example of identical data needs, take the case of the Department of Motor Vehicles, the Highway Department and the Highway Patrol; they all need basic information relating to accidents. The Department of Motor Vehicles has financial responsibility, the Highway Patrol has control over the driver, and the Highway Department has responsibility for the roads over which the driver and car travel. All are concerned about the accident problem and related driver education problem. What happens when a driver has an accident? Typically, three copies of the accident report will be sent to three different agencies, and, if they have their own data processing center, the information will be key punched three times.

A similar duplication exists for traffic violations. One traffic ticket may have three parts; one part going to the city, another to the county, and still another to the state. Again, all three governmental units key punch the same data and prepare nearly identical reports. In both cases it would be less costly and more efficient to key punch the data in one location and then abstract the relevant information for individual agency use; in other words, to develop an integrated input system.

There are some real benefits from this integrated approach, not only for the agencies, in terms of costs and efficiency, but also for legislators. If legislators require data, say on mental health, they will probably talk with the Department of Health, the Department of Welfare, and the Department of Institutions. An integrated system would support the needs of all three agencies but still allow the legislator to go directly to a single file and obtain all of the information necessary for mental health planning.

Although there are major benefits from any of these three approaches, there are many problems of implementation. First and foremost, they all represent a change in government and change takes time and money. Where will the money come from? How should these services be billed to the respective agencies? How are the advantages substantiated? Who will bear the charges for joint systems development and how is the money to be raised? All these questions must be answered, and their answers, in turn, represent very real problems. Secondly, there is a problem centered around the parochial attitude of administrators; administrators have great difficulty in agreeing on the goals, let alone the methods to achieve these goals. In one state it took about five months to get two groups to agree on the necessary changes in a health card punching system. The entire argument concerned the appropriate column for a particular type of data.

A third problem could be called the physical control syndrome. Most agencies refuse to let their data out of sight; they refuse to send it across the street to a commercial service bureau or to a state service bureau. It is extremely difficult to convince agencies that controls can be operative even when the information is out of sight. And, of course, there is a tendency to presume that if the "black box" is located elsewhere, the control lies elsewhere. The answer to this problem, barring legal considerations, essentially lies with education. It can be proven, for example, that you can control a system without necessarily having the system physically within your control.

The legal considerations can limit the possibilities. In some cases physical control over warrants and other material is expressly limited by statute. Many of our present laws have to be revised to permit more efficient data processing techniques.

Discussion of legal considerations brings up the problem of confidentiality. Most information today is kept confidential, not necessarily by design, but by the type of records maintained by agencies. The information is so disaggregated and disorganized in a multitude of manual files that it would be impossible for any unauthorized personnel to draw enough information together to be a threat. Thus, the information is automatically secure.

Confidentiality is not automatic under an ADP system; although information may still be in several files, the computer allows us to enter these separate files easily and rapidly. It now becomes practical to pull together information about people and unless attention is given to a control system, unauthorized persons may have access to confidential files.

Nevertheless, there are risks of equal importance under today's system; that is, an agency may be maintaining the confidentiality of its records under the present data storage methods, but there are equally grave risks in making decisions with inadequate or incomplete information. Today, agency directors have the ability to filter any information going out of their agency. They can tell budget directors, legislators, federal auditors (and perhaps they have a right to) almost anything, and there is no way for the inquirer to prove or disprove the statements. They can always maintain, and rightly so, that the information is impossible to obtain. Consequently, the executive and legislative groups are never really sure their planning efforts are using proper facts.

A large computerized system threatens not only the confidentiality of the information, but also the personal privacy of the agency directors. Suddenly there is a visibility into the naked organization. Governmental agencies are frightened when, after 100 years of complete freedom to filter information, other authorized parties may directly examine agency records and performance. But writers over many years have maintained that the dictators of the future will not gain power by physical acts; instead they will manipulate individuals by securing confidential information about them. Agency directors and executives must be concerned about the problem. Simply adding files to an existing information system without considering the problem may threaten the very existence of democratic power. To my knowledge there is no confidentiality or security technique available today which is foolproof; usually they can be refined to the point that the probability of unauthorized access is pretty low, but there are no guarantees in this business. The fact that there are problems of confidentiality does not mean that centralized computer services should be avoided; instead, it means that when you adopt such a system you should constantly try to develop ways of handling the problem. Centralized services represent an efficient approach to state agency data processing needs and it is time to recognize both the advantages and the disadvantages.

Practical Application of Computers in the Public Schools

DUDLEY SOLOMON

Dr. Solomon, Director of Senior Education, Jefferson County, Colorado, has been involved in the field of education since 1954. A well-known lecturer and educator, Dr. Solomon has served as consultant to various public school systems and has been instrumental in developing many computer applications now in use throughout Colorado.

DUDLEY SOLOMON

Practical Application of Computers in the Public Schools

The first area of concern in the practical use of computers in public schools are the people involved. In our school districts, both at the state and local level, the first person concerned is a chief administrator or the state superintendent, part of whose job is to keep up with change. The next is the school board members who need to be convinced that a computer or any other new innovation is what we need in the school district. Then there are parents who want to know what the computer is going to do for their kids. Then comes the student who wants to know how the computer will help him in his studies. Next comes the teacher, who among other things, wants to know if the computer will replace him or her. Others not so directly involved range from the governor and legislators to the programmer or operator who actually runs the machine.

About six years ago, I went to Stanford to appraise computers and learn their application in school systems. The first thing I had to do there, was to define the goals of my particular department. So let me point out that you too must define your goals and objectives; if you cannot, find an analyst and discuss your situation with him. If you are dealing with several other departments; form a committee and decide on the type of program you want. This can form the basis for any system you propose.

Before I go any further, let me give you a definition of systems approach. In education the systems approach should be regarded as a disciplined way to analyze, as precisely as possible, the interrelationships of various activities, and to formulate comprehensive and flexible school plans on the basis of that analysis. Using this approach at Stanford, we were not only able to utilize the computer (Stanford 360-50), but we also came up with what is now called flexible-type scheduling. What did this schedule do? The flexible schedule analyzed our present educational system and, for the first time, asked simple questions to which we have never before paid any heed. What are we really doing with students? Why should certain subjects be taught one hour a day, five days a week, and for 185 days a year? Are all subjects of the same importance? Are all teachers of the same quality? Do all students have the same learning ability? Today's school personnel do not have answers to most of these questions, even though they are important. In Colorado, it took us three years and 200 people including educators, management personnel, and engineers to answer some of these questions, and come up with our first model. Then we could move toward individualized instructions.

Although it only took 15 minutes to run our model through the computer, the school administration had to spend hours in preparing the necessary data. Individual administrators needed both questions and specific answers. What is the size of his building and what is its capacity? What type of teachers and students does he have? Does he have the support of all the people involved, from the student to the superintendent? To become aware of all factors involved he had to ask similar questions of his teachers. How do you justify teaching this particular subject the way you are doing? How do you justify some of the programs you are involved in? The results of these queries were quite illuminating. We found how thoroughly erroneous and unjustified some of our programs and our teaching methods were. A computer was important here because before we could use the computer we had to analyze the questions mentioned above.

Microteaching developed from the use of computers. With microteaching, a small segment of a lesson plan can be video-taped and analyzed afterwards. This analysis can determine how well the teaching process is proceeding. Throughout the country in the teaching profession, we have a system known as tenure, which says that after three years of teaching, the teacher may be released only for gross incompetence. Through microteaching techniques we now have an efficient way of evaluating teachers, which may be noted as one of the "bonus" uses of the computer.

The computer has brought about a conceptual change in the area of scheduling. In a traditional school system, we have a six-period day and a five-day week; we put up a master board with the required subjects, and the students make their own selections after discussing subjects with their parents and counselors. In a flexible schedule, after the students select—with the help of counselors and parents—the subjects they want to take, the computer builds a schedule. This may not sound like much of an accomplishment, but to educators this is probably one of the biggest breakthroughs that has happened in a number of years. The flexible schedule approaches the scheduling problem from a different angle. It looks at the working day in terms of 20 or 22 minute modules of time or space openings; in other words, there are probably 300 space openings a day where students can fit into the program. With this system, teachers spend 50 percent of their time in actual class teaching and the rest in individualized instruction.

This is how it works: after consulting with the department, the teacher will decide on the best way to teach a subject. Let us say the course is woodworking. Traditionally, we teach it for one hour a day, five days a week. By the time the student goes to class, draws his tools, works for ten or fifteen minutes, then cleans up the room for the next class, the hour is gone. Analysis indicates that probably the best way may be to teach the course 2 times a week for two or three hours a day, so that the student may really get involved. In mathematics, however, it may be better to have shorter classes—say 20 to 40 minutes— and leave the rest of the time for teachers to work individually with students.

Math is one place where the computer is invaluable, in providing computer-assisted instructions. Let me illustrate this. In Pittsburgh, for example, with IPI (Individualized Program Instructions) about 80 students in fourth and fifth grades sit down at consoles (a new computer teaching tool) and learn math with the help of only one instructor. The program appears on the console and the student using a typewriter talks to the computer. "Good morning, I am Johnny, No. 2930." The computer reaches in its memory for Johnny's file and answers, "All right, Johnny, we are ready to go. Yesterday you did so many problems correctly and so many incorrectly. Let us see how well you do today." The computer then presents programmed instructions which have been specifically designed for Johnny. How did the computer know about Johnny's needs? Prior to starting him on this program, the instructor was used as a diagnostician to evaluate Johnny's ability, comprehension, spatial application, etc. Based on the instructor's recommendations, a program was devised and fed into the computer. Now when Johnny starts to work his mathematics, the computer tells him if his answers are correct or incorrect. If he does a problem incorrectly, he will raise his hand and the teacher will immediately help him with his specific problem. Johnny can then proceed to the next problem.

Other states also have such programs in the planning or operation stage. New York is working on its NYSEIS—New York State Educational Information Service—involving four regional centers. California is working on computer-system instructions, and so is Illinois. Whose responsibility should it be to tackle this problem of computer use in education? I think it should be the state's. There is not another organization as well suited to help bring this revolution about. I know that using the word revolution might be a little harsh, but I think we are ready for it in education.

Utilizing the computer for many clerical tasks provides additional time in which to develop other worthwhile programs, not necessarily computerized programs, but ones which further the educational facilities available to the student. Let us take the national and statewide problem of dropouts. In my school district, which has 62,000 students and 119 schools, we started a special free school for dropouts. We established one entrance requirement—normal behavior. We have a lot of students in our state who have dropped out for various personal and emotional reasons. They are all allowed to enter the program if they promise to behave normally.

As soon as the student decides to enter the program, he is assigned to a counselor who talks to the student and makes a "profile" of the student based upon his particular needs. Let us say the student shows a high aptitude for mathematics but requires two mathematics courses to graduate. He will then be asked to take a test for each required math course, and if he passes, full credit is granted, thus allowing him to move ahead. In this kind of program, the student is motivated to complete his courses and move towards his goal of obtaining a diploma. Furthermore, industry has been receptive to students who have completed our program and this has given further impetus to the dropouts to enroll in the program.

PLANIT—Programming Language for Interactive Teaching—is another program that may be of interest to you. In this program the teacher sends a memorandum to a state computer service bureau indicating that a student may need the use of a computer. From the data received from the teacher, the computer analyzes the needs of the student and sends back a set of programmed instructions for a certain course. The student then works with the state computer on a nongrade continuous type of course. There are a variety of programs available in this area. For example, there is one known as POLLUTION. This program involves an undeveloped imaginary city, and a group of students are allowed to design and plan homes, factories, and all other facilities that make a modern community. Here is where the students have to analyze concepts and make decisions with the help of computers. What will happen if they allow more pulp mills to be established? What effect will such mills have on the general health and economy of the city? What will happen to the fishing and tourist industry if the industrial waste is dumped into the rivers? Hopefully, these programs will help them to cope with real life problems which they may face in the future.

In summarizing, let me point out that the results of the computer in academic areas has been to develop humanized and individualized instructions.

No longer are we looking at students only in groups. We are now looking more closely at the individual and his performance.

The number of computer-oriented aids in the area of education are ever increasing. To name a few: 1) dial access system; 2) programmed instructions; 3) individualized instructions; 4) projected material; 5) media for group instructions; 6) non-projected material. Management, administrators, and the teachers must be educated in the use and possibilities of these and many other new programs. But let me remind you that in educating these people we must not completely downgrade past methods or practices, and we must allow sufficient time for adjustment. Once you have implemented a program, review it with the people involved and do not hesitate to revise or change it if it does not meet your specific needs.

The cost of education is skyrocketing. Besides the normal inflationary increases, we have increased building, equipment, and material costs due to ever-increasing enrollment. To all this a relatively new factor has been added which must be reckoned with: the new and strident demand of teachers for better salaries, bigger benefits, and better facilities. No longer are these people content to wait for the changes. They are demanding them!

By the use of computer analysis, pilot schools in California, Colorado, Illinois, and New York are initiating what is called differentiated staffing. The teachers will not be hired on a set salary scale, but will be paid what they are worth as educators. This may be one answer. With the increased costs the time is coming when the people who fund these programs want to know what it really costs to educate a child. Unfortunately, in most cases we have yet to come up with a per pupil cost of any program. The taxpayers will also want to know what a particular program or curriculum has actually accomplished. For example, is a Latin or French program actually fulfilling its objectives? Do we need six years of required mathematics? Some of these questions are already being asked. Let me remind you that if you want to use computers in education, these and many similar questions have to be answered first. We are going to have to define quality in education and then reassess our programs using this definition as a yardstick.

As I mentioned before, the use of computers in education is limitless, and we must get started. As an example, we are currently doing a lot of work in the area of guidance—permanent records, use of resource centers, accident and safety reports, correlation between attendance and grades, computer system instructions, data base, modulate scheduling, and a myriad of other tasks. In the Denver metropolitan area, seventeen of the largest school districts have merged and use one computer center for all of the services just mentioned. The state is promoting it and will provide funds. We are looking forward to setting up another regional center within two or three years. Computer-based education is a job for the state, and I am hopeful that all states will assume the responsibility and bring these changes about.

Tomorrow's Challenge for Today's Managers

PATRICIA P. DOUGLAS

Dr. Douglas, Assistant Professor of Finance and a Research Associate with the Bureau of Business and Economic Research, University of Montana, is also the Director of Montana Technical Services. She has worked as a consultant to Montana's Department of Planning and Economic Development and was recently appointed to the Advisory Council, State Library Commission.

PATRICIA P. DOUGLAS

Tomorrow's Challenge for Today's Managers

A title such as "Today's Challenge for Today's Managers" more accurately reflects my thoughts on computer technology because I doubt that we can afford to wait until tomorrow. So, if the rest of the speakers will allow me to reconstruct some of their remarks and add some of my own thoughts, I would like to explain the challenge which lies ahead of you—the decision makers for Montana and states like Montana.

Beginning with the Governor's remarks yesterday and ending with Dr. Solomon's discussion concerning school districts, we are indeed aware, or should be, of the many changes which are occurring in state and local government; many of them center around information technology. It is no accident that the majority of discussions you heard in the past two days always get back to a consideration of information flow—be it among levels of government, among administrators in a single agency or department or between government and outside organizations. We have spent a number of years changing other aspects of Montana; we have dealt with the physical aspects of a community, the elements which make them more attractive to the local citizens and to potential industry; we have passed enabling legislation for particular sectors of the economy; we have expanded the services of specific agencies and decreased the services offered by others—depending upon the changes in demand; we have revised organizational structures which permit us to apply to the federal government for help in reaching the goals of Montanans; we have expanded our educational, transportation, recreational and special institution facilities; and so on. It is amazing that all these decisions have been made at all, let alone with any degree of accuracy, because there is one aspect we have not changed and that one aspect is the base upon which all of these decisions are made. That one aspect is the information structure of government.

We have always known that good decisions are based on good information, and the existing structure was adequate at one time, but the conditions necessary to obtain good information are changing. It is no longer possible to shift through the seemingly endless reams of paper that pass over our desks to obtain that data which is relevant to the problems or decisions at hand; the volume is too large and the intermingled garbage too excessive. If we take time to consider each and every piece of paper, we had better start measuring production by the number of hours we spend making a decision, the number of phone calls it takes to clear up the misinformation and the number of miles traveled to get to the original source. I think all of you will agree that these are not really measures of production, but rather indicators of our inefficiencies in handling information.

Coincidental with the monumental increase in the amounts and types of information or misinformation that pass over our desks is the increasing pressure from higher administrative levels, including the federal level, to expand and improve the quality of information processed within our own operations. For example, each federal program we apply builds resources to tackle state and local problems; but each federal dollar has a matching requirement of "X" volumes of paper concerning the disposition of these funds, the evaluation of the results, plus a detailed description of the people participating in our program; not to mention the required statement of plans for the future. The existing informational structure in this state is inadequate to handle either the additional input or output.

During the last two days we have been given some ideas on the procedures for reconstructing an informational set-up which is better equipped to handle our needs, along with the problems we face in trying to use those ideas. Let me briefly summarize some of the key remarks: first, even though building an information system is a formidable task, we should not be discouraged: others, such as the Atomic Energy Commission, and the Internal Revenue Service, have successfully tackled more difficult informational problems with fewer resources.

Secondly, if we put together the pieces of the information systems the speakers talked about, we would find that there are three distinct, if you will allow me to use one of the current buzzwords, information subsystems. The first information subsystem is that which ties the executive, legislative and judicial branches together and allows them to relay information and requests, as a unit if necessary, to corresponding administrative positions within federal and local governmental units.

Secondly, there is the information network which operates within the executive, legislative and judicial branches. To get some idea of what this looks like let us use the executive branch as an example. Information and data processed internally which relates to operations—policies, budget provisions and personnel—or that which relates to external factors are transmitted to individuals within the executive branch, within state agencies or within local governmental units, and back and forth up this hierarchy. These informational ties are self-explanatory with the possible exception of the one between state agencies and local governmental units. A typical example of that tie would be the school district reports to the Department of Public Instruction, or the Clerk of Court's report to the Board of Health. The internal subsystem for the legislative and judicial branches would be very similar to this one.

The third and final information subsystem links the two we just talked about with all the information networks which exist, either explicitly or implicitly, outside the normal governmental units. These external networks include the information which is available through research organizations, industry, the press and private citizens. Typically, we tend to disregard this subsystem because it is not within the confines of government. However, if we stop and analyze the situation we will find that we make very few decisions which do not utilize someone else's information.

A third and very important point which a number of the speakers made concerned the necessary prerequisites to deal with one or all of these types of information subsystems; although I may have overlooked a few, these seem to have been the important ones.

Complete involvement of the top decision makers within the unit trying to establish a good information system is the first prerequisite. Another way of stating this is that you should not intend to get the kind of information system you want by hiring hardware or programming experts. They probably know more about hardware than you do, but they certainly know much less about the information subsystems described earlier. I might add a parenthetical note here relating to the conferences similar to this that we ran for businessmen: those businesses which sent top management are now in a position to begin evaluating the role of automation within their firms—be it for or against a specific application. The majority of those firms who sent only their data processing personnel wasted the registration fee because, without the involvement of management, the data processing people could do nothing. The same is true in government. Those of you heading federal, state and local agencies must become involved in all of these efforts.

The second prerequisite concerns the willingness to cooperate in a joint effort. The kinds of developments we have been discussing the past two days are much too expensive and time consuming for each agency and department to undertake individually. A meaningful dialogue must exist among the various levels of government and within each level. Take the current effort which many of you are involved in—that of using multi-county districts for planning. If 43 state agencies and 800 federal and local agencies all insist upon using their own special version of multi-county lines, very little will be accomplished. Each of you will then have to use a different set of standards to evaluate the performance of programs; you will have little commonality in discussing planning objectives, and you will all report individually, in some cases for identical goals, to a number of different agencies. This represents a considerable waste of time and money.

A third prerequisite, perhaps the most important one, is a clear definition of your needs. What kinds of information do you require which you do not now have to make the decisions of today and tomorrow? What form do you want this information in? What other departments rely on you for information and whose information do you use to make your decisions? This prerequisite suggests that: no matter how skilled you or your personnel are, regardless of the impressive size of the equipment you purchase to do the job, and irrespective of your fine attempts to cooperate, you will not be able to use the hardware, software, the total information system or a planning-programming-budgeting system to your advantage unless you have a clear idea of your individual needs and future goals.

With these prerequisites—the involvement of top administrators, a cooperative spirit, and well-defined goals—you are in a position to make a pretty strong case for the fourth prerequisite, i.e., sufficient resources to implement your decisions. This is a tough prerequisite to acquire: you can make a convincing argument for spending so much money for computer purchase or rental if you can show a reduction in related costs—staff time or clerical salaries—but for the kind of changes we are talking about the advantages will not necessarily be measured by cost reduction. And just how do you project the cost savings from better decisions? Even more difficult to substantiate than hardware costs, is the related costs of skilled personnel, the design work and so on. The type of people you will need to help you do not come cheap; they are in great demand so they, in turn, demand a high salary. You can afford to make a mistake in updating office typewriters but you cannot afford the same laxness when evaluating people to help you implement an information system—the wrong choice here could cost you ten times the salary commitment.

Having firm commitments for interagency cooperation, administrative involvement, well-defined goals and resources, a state like Montana can tackle many formidable information problems, whether those problems relate to internal data processing, an interagency information system or a statewide information network.

And problems you will have, as most of the speakers have mentioned. You will have people problems. Only a dreamer would presume that all federal, state and local agency personnel are going to welcome change. Many will not welcome your proposals, especially if those changes involve the use of computers. Some of your opponents will, in fact, work diligently to prove that the proposals will not work. Your problem lies in guiding those dissenting energies into avenues which further, rather than hinder your progress.

You will have hardware problems. It is an extremely difficult job to evaluate the potential of computers as applied to specific internal and external information problems. It is even more difficult to determine the time schedule for implementation. And as several speakers pointed out, hardware problems do not cease when the evaluation has been made. Some of you will make an improper evaluation, in which case you will be constantly updating your equipment and/or personnel. Even adequate equipment must be utilized and maintained—not horrendous but nevertheless continuing problems.

And above all you will have what I might call integration problems. These integration problems are magnified by practical politics. Although we have not given you much time to digest the information presented during the past two days, stop and reflect for a moment, if you will, about the task of coordinating those activities currently underway in Montana, not to mention those which will undoubtedly materialize within the next six months, a year or five years.

Suppose, as an example, that a number of state and federal agencies within Montana decide that the best solution to their internal data processing problems is to build a truly self-servicing and completely centralized processing department for all phases of data and information handling. As you well know, the cost of operating one of these centralized services decreases per unit as the volume processed increases. Suppose further that a couple of major agencies decide not to buy the idea—the ones with the really big data processing requirements —either for political or administrative reasons. Can you foresee the difficulties? I certainly can. I am not purposely trying to paint a bleak picture, but from a practical point of view, I know that it is going to be impossible to get involvement from all those who should be involved. In fact, it usually works out that those who should be the most concerned are the least interested. The leaders among you will have to face that eventuality. And although the speakers may not have been too explicit in this connection, you will find from the experience in other states that those most heavily involved are going to have to proceed at some point while the others stand back and watch. At that point when you are implementing those proposals, it comes down to this: you give the dissenters a choice of participating or not participating. If they decide not to, they, and not you, have to face the legislative question of why they are duplicating within their own agency what the rest of you have developed cooperatively. It must ultimately be the legislature, with the purse strings, who forces the stragglers to progress. This presumes that legislators are familiar enough with these concepts to recognize duplication of effort and resources, a presumption that will not always be correct. Thus, you have, in addition, a problem of educating the legislators.

In short, the challenge facing Montana's administrators is, indeed, great. With limited resources you must educate your own personnel, the legislature and the general public so that they understand the importance of a total information concept for the state. During the past two days the speakers have discussed some ways and means of promoting that educational process. Beyond that, the job of coping with the problems, the mandate to develop practical solutions, is yours. The discussions presented at this conference, the advantages and pitfalls of computer applications to information problems, can serve as guidelines for your work. This conference has been, in my opinion, a valuable first step in this educational process.

ALLIED PRINTING TRADES UNION LABEL COUNCIL MISSOULA 55